Stormwater Pollution Prevention Handbook

Conservation
TORONTO AND REGION

Ontario

2001

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Stormwater Pollution Prevention Handbook

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PREFACE

Pictures of Pollution

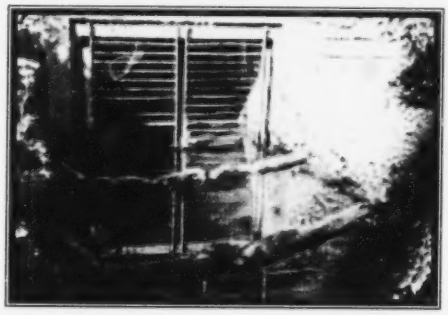
These photographs show examples of how pollution from different sources affects our lives. Our initial image of pollution is that of an industrial polluter releasing chemicals into the air and water. A closer look will reveal that our everyday habits also contribute to pollution such as chemicals and toxins from our vehicles, waste, the things we purchase, and pesticide use. We are slowing poisoning and choking the systems that sustain us.

Is there hope that this will change? The employees that strive to achieve an ISO 14001 standard for their workplace think so. So do the children that paint Yellow Fish signs on storm drains in their neighbourhoods. So do municipal councillors as they develop pollution prevention plans for their town or city. With the right information and support, many others will work towards reducing pollution in their community. It is cheaper and more effective to prevent pollution happening than it is to repair its damage and cumulative effects on our environment.

This handbook is not a policy document. It is intended to provide practical guidance to municipalities in implementing pollution prevention and flow reduction programs related to stormwater runoff and combined sewer overflows. Although this manual is semi-technical, there is something for everyone who is trying to reduce pollution at its source. Users will include community groups, businesses and many others.

The text explains the sources of urban pollution and its effects. It details many measures that can be taken to reduce pollution at source. Fact Sheets, Case Studies and useful references are provided to help learn from real life experience. This handbook will have done its job if it encourages municipal councils, business and community groups or individuals to evaluate their work and leisure practices and make some change for environmental improvement.

Summer storms may leave streets, driveways and parking lots appearing fresh and clean, but the debris and film of waste that washes from these surfaces makes its way into the storm sewers and eventually to the beaches. Beach closures can result from bacteria from the streets (pet litter) and from sanitary wastes when combined sewers overflow after heavy rains.



Local creeks and watercourses receive the drainage from urban streets and also any waste materials and toxins that are introduced to the storm sewers by accident or design. Phosphorus and other nutrients from lawn care products also impact on the streams, causing heavy algae growth, and using up oxygen that is vital to fish an other stream-creatures.

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1 BACKGROUND

With the support of the Ontario Ministry of the Environment (MOE) and the Government of Canada's Great Lakes Sustainability Fund (GLSF), a number of municipalities have carried out Pollution Prevention and Control Planning (PPCP) studies to deal with water quality problems resulting from combined sewer overflows and urban stormwater runoff. Although appropriate pollution control aspects were emphasized in all the studies, the prevention of pollution at source was not emphasized to the same degree in many of the PPCP studies. This may be due to insufficient experience in implementing pollution prevention programs. The situation is also aggravated by other influencing factors such as a perception of inconvenience by homeowners, insufficient experience with infiltration practices and lack of municipal control over private property. MOE's Procedure F-5-5, Determination of Treatment Requirements for Municipal and Provincial Combined and Partially Separated Sewer Systems, is a policy document for controlling combined sewer overflows (CSOs). One of the required minimum controls for municipalities with combined sewer systems is to establish and implement pollution prevention programs. The Ministry also has a Stormwater Management Planning and Design Manual that provides guidance on lot level controls and conveyance controls for stormwater runoff.

It was recognized that there was a need to document examples of municipal pollution prevention programs that have been successfully implemented with the aim of generating practical ideas and guidance through disseminating the experience gained from other municipalities to effectively manage stormwater runoff and reduce combined sewer overflows. Although pollution prevention can encompass a comprehensive range of municipal activities this handbook focuses on the storm, sanitary and combined sewer systems and their contributing flows and emphasizes the practical implementation aspects.

This report is a joint project between, MOE, GLSF and the Toronto and Region Conservation Authority (TRCA), with participation from the Cities of Mississauga; St. Catharines; Toronto; Waterloo; Quinte Conservation; and the Municipal Engineers Association.

1.1 Project Goals and Objectives

The goal of this handbook is to provide practical assistance to municipalities in implementing pollution prevention and flow reduction programs related to stormwater runoff and combined sewer overflow.

The conventional definition of pollution prevention includes measures that reduce the amount of pollution at the source. In stormwater management terms, this applies to activities that reduce the application of pollutants to urban surfaces. These activities include applications of fertilizers to lawns and salt and grit to roads, as well as introduction of oil and other chemicals into drains. Many of the negative effects of urban runoff are also attributed to increased volumes of runoff, resulting in flooding and channel erosion in streams. Combined sewer overflows occur because the flows in the combined sewers exceed the capacity. Reduction of the volume of runoff will also reduce pollution. In this handbook, consideration is given both to flow reduction measures and pollution source controls.

This Stormwater Pollution Prevention Handbook:

- Documents existing pollution prevention and flow reduction practices or technologies, and provides graphical illustrations. These measures are categorized according to their applications, opportunities, limitations and operation and maintenance considerations. Cost estimates for implementation of each practice should also be incorporated. Operation and maintenance costs should be included where appropriate.
- Documents pollution prevention and flow reduction projects or programs that have been implemented at the municipal level in Ontario and elsewhere. It compiles information such as program rationale and cost, factors affecting implementation, environmental benefits and stakeholders involved in the programs. The documentation also includes the steps involved in implementing the projects or programs. With the illustration of actual case studies, potential problems or barriers which have been encountered in the implementation of pollution prevention and flow reduction programs are discussed and recommendations are provided.
- Shows how pollution prevention and flow reduction projects and programs can be implemented as part of a municipal environmental management system and shows also how they can be documented as part of a Pollution Prevention and Control Plan to address CSO and stormwater runoff.
- Illustrates community-based social marketing and public education and outreach approaches to improve homeowners' knowledge and increase their participation in water pollution prevention programs.

The purposes of the Handbook are to:

- define pollution prevention and urban hydrology concepts,
- describe pollution prevention and flow reduction techniques,
- provide information on implementation approaches at the municipal level,
- serve as a technical resource in preparing pollution prevention and control plans and municipal environmental management systems plans,
- provide resources and advice on public consultation and outreach programs.

Who Are the Users?

This handbook targets municipal corporations, although many other agencies and organizations will find it useful. A municipality contains a variety of land uses such as industrial, commercial, institutional, residential, road and rail transport and utility corridors, parks and natural areas (streams and valley lands). All these land uses are potential targets for pollution prevention initiatives. This handbook focuses on residential and municipal practices, although industrial and commercial pollution prevention and control programs are also discussed. The primary users of this handbook are:

- municipal staff;
- residents and community groups;
- commercial and industrial businesses.

Municipal programs and policies directly and indirectly control commercial and industrial activities within the municipality and so can influence pollution prevention. Consequently, the handbook will identify opportunities for community or municipal actions to affect industrial and commercial activities, but will not attempt to give complete coverage of the applicable pollution prevention programs.

The handbook is organized into three parts:

Part I - Pollution Prevention Planning and Implementation

Chapter 1- An outline of the purpose of this handbook with a discussion on pollution prevention, the issues surrounding the concept, and how it fits into municipal servicing and pollution control initiatives (past and present).

Chapter 2- An overview of the pollution prevention measures available and introduction to the Fact Sheets on the measures provided in Part II of this handbook.

Chapter 3 - A discussion on how to set up and implement a pollution prevention program.

Chapter 4 –A summary of the use of public outreach for pollution prevention.

Chapter 5 - The use of social marketing in the implementation of pollution prevention programs.

Part II - Pollution Prevention Measures Fact Sheets

The fact sheets deal with source prevention, flow reduction, municipal operations and local drainage.

Part III - Case Studies

This section includes examples of watershed studies, municipally-based pollution prevention studies, and flow reduction programs. The case studies include a range of community sizes and resources, the approaches used to deal with pollution problems, and the effectiveness of the approaches:

- Centennial Creek Subwatershed;
- Emery Creek Environmental Association;
- City of Belleville Pollution Control Plan – Bay of Quinte Area of Concern;
- Town of Ancaster;
- City of St. Catharines;
- Regional Municipality of Waterloo;
- City of Hamilton;
- Toronto Watershed Infrastructure Ecology Program (WIEP).

2 INTRODUCTION

2.1 Urban Runoff Pollution – What is the Problem?

Urban land uses generate residual and waste material from a myriad of individual and group activities. Each type of land use has unique characteristics that result in the generation of pollutants and runoff volume. Density or intensity of the land use and percent imperviousness also play a part. These factors also influence the pollution prevention and flow reduction opportunities.

Pollution Sources

- **Vehicular traffic** accounts for much of the build-up of contaminants on road surfaces. Wear from tires, brake and clutch linings, engine oil and lubricant drippings, combustion products and corrosion, all account for build up of sediment particles, metals, and oils and grease. Wear on road surfaces also provides sediment and petroleum derivatives from asphalt.
- **Lawn and garden maintenance** in all types of land uses including residential, industrial, institutional parks, and road and utility right-of-way accounts for additions of organic material from grass clippings, garden litter and fallen leaves. Fertilizers, herbicides and pesticides all can contribute to pollutant loads in runoff.
- **Air pollution** fallout of suspended solids from traffic, industrial sources and wind erosion of soils builds up contaminants in soil.
- **Municipal maintenance** activities including road repair and general maintenance (road surface treatment, salting, dust control, etc.).
- **Industrial and commercial** activities can lead to contamination of runoff from loading and unloading areas, raw material and by-product storage, vehicle maintenance and spills.
- **Illegal connections** of sanitary services to storm sewers can cause contamination with organic wastes, nutrients and bacteria.
- **Illegal disposal** of household hazardous wastes can introduce waste oil and a multitude of toxic materials to storm and sanitary sewers.
- **Transportation spills** from accidents can occur on heavily travelled arterial streets and highways.
- **Construction activity** can introduce heavy loads of sediment from direct runoff, construction vehicles and wind-eroded sediment.
- **Pet faeces and litter** introduce organic contamination, nutrients and bacteria.
- **Combined sewer overflows (CSOs)** contain a mixture of sanitary, commercial and often industrial waste, along with surface drainage. CSOs can contain high levels of nutrients, suspended solids, metals, organic contaminants, oxygen demanding substances, bacteria and viruses.
- **Runoff** from residential driveways and parking areas can contain driveway sealants, oil, salt, and car care products.

Pollutant Impacts

The receiving water quality impacts from municipal discharges vary depending upon the quality and quantity of the wastewater and the assimilative capacity of the receiving waterbody. Potential water quality concerns resulting from CSOs and stormwater include:

- bacteria from faecal material in pet and wildlife litter and sanitary wastes in CSOs causing beach closures;
- nutrient enrichment, from nitrogen and phosphorous compounds, which can lead to nuisance growths of algae in the receiving waterbody;
- deposits of contaminated sediments, which can lead to degradation of benthic (bottom-dwelling) organisms and restrictions on dredging;
- toxicity from ammonia, metals, organic compounds, pesticides and other contaminants, present in the runoff and overflows; also potential endocrine disruption effects from certain organics and pesticides;
- oxygen depletion potential or biochemical oxygen demand (BOD) of the wastewater from biodegradable organic material, which can lead to oxygen deprivation of the organisms in the receiving waterbody;
- temperature changes due to an influx of water warmed by the 'heat island' effect of roads and buildings;
- aesthetic impacts from floatable matter and sediments (i.e., litter, grass clippings, sanitary items, soil erosion, etc.);
- contamination of groundwater with soluble organic chemicals, metals, nitrates and salt.

2.2 Hydrologic (Water) Cycle

The concept of the hydrologic cycle is used as the basis for understanding watersheds and, in particular, response of runoff and flow to precipitation and uses of water within the watershed. The hydrologic cycle concept describes the process of motion, loss and recharge of water within a watershed. A comprehensive illustration of the water cycle continuum is provided in **Figure 2.1.**

As shown, the major components of the hydrologic cycle are precipitation, evaporation, surface runoff and groundwater. Watershed management (including the pollution prevention measures in this document) is directly targeted at the runoff component, either through managing runoff processes and infiltration / recharge; or controlling contaminants entering runoff (i.e., pollutants). Some prevention measures also influence evapotranspiration including those that relate to the types of vegetation and storage, i.e., grassed waterways, vegetative buffers.

The most important item to recognize from a management perspective is that the hydrologic cycle does not have a beginning or end. As water evaporates from the land or water surfaces it becomes part of the atmosphere. Water is stored until it precipitates to the earth where it is intercepted by plants and water surfaces. The precipitation which lands on the ground will either runoff or infiltrate. In Ontario, approximately one third of the intercepted water returns to the atmosphere by evaporation. Infiltrated water is stored in soil to be used or evapotranspired by plants, or travels deeper into the soil and eventually discharges to the receiving water bodies.

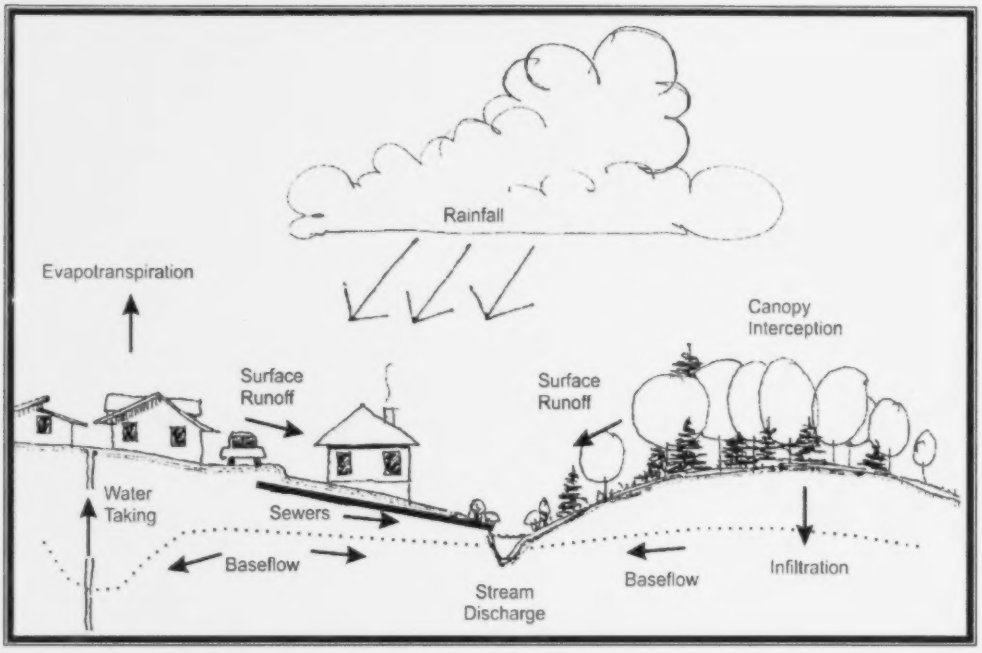


Figure 2.1 - Hydrologic Cycle Components

Impacts of Human Activity

Human activities affect or alter the water cycle in many ways. The major link in a watershed ecosystem is the flow of water. In a natural watershed, topography, geology, soil type and vegetation control water flow. How and where the water flows determines the quantity and quality of the water, the shape and stability of stream banks, the state of the groundwater, the health and diversity of vegetation, and the availability of fish and wildlife habitat.

As human activities increase in a watershed, all these natural characteristics can change. These human activities can change land drainage patterns, remove vegetation, or pave previously porous areas and consequently allow contaminants such as road salt, oil residues and pesticides to enter local streams. Unstable and eroded stream banks, poor water quality and loss of fish and wildlife habitat result, eventually diminishing the quality and quantity of surface water and groundwater and reducing the ability of humans to use and enjoy watershed resources.

Hydrologic Cycle and Pollution Prevention

Where water acts as the primary conveyor of pollution, pollution prevention measures can reduce pollution impacts by preventing pollutants from entering the flow (hydrologic cycle), or by controlling the flow (i.e., flow reduction measures – Fact Sheets Part II). In the development of an effective pollution prevention or management strategy, it is critical to understand the hydrologic cycle process to ensure that the measures are selected and implemented in an appropriate manner.

Management Implications

The impact of urbanization with the resulting input of pollutants, result in deterioration of water quality and ecosystem conditions. A watershed based management strategy provides an understanding of the ecosystem processes and helps to develop management measures to mitigate or prevent the impacts of urbanization. Common impacts considered in watershed plans and resulting management options are outlined in **Table 2.1**

Table 2.1 – Hydrologic Impacts

Hydrologic Impacts	Water Strategies or Options
• Increased runoff (volume, frequency and duration) with impervious ground cover.	• Runoff control for flood and erosion protection • Measures to maintain existing recharge rates.
• Reduced baseflows in streams because of land use changes.	• Provide measures to maintain infiltration • Provide extended detention of runoff for low flows.
• Increased pollutant loadings with runoff.	• Provide measures to reduce pollutant sources, or remove pollutants, by settlement, absorption or filtration.
• Erosion changes to stream form.	• Infiltration for control of runoff volume. • Rate of runoff control for erosion protection

Drainage systems be it natural or designed by humans, have always served the basic function of containing and transporting water (and other materials) away from a source area to a selected discharge point. The basic concept has the same principle as a stream system in that it generally follows a tree pattern. The upper branches are smaller and distributed to pick up a number of source areas and all carry the water to downstream junction points where the branches become larger. The main collector or trunk is the largest and leads to one discharge point.

Conventional drainage systems follow the principles of a stream system to convey flow with the main difference being that drainage is confined to a pipe or constructed channel that provides a specific capacity. If this capacity is exceeded the system may surcharge with resulting flooding of the source areas.

Evolution of Urban Drainage Systems

The design of urban drainage systems has followed an evolution to serve the needs of the day. The process is described below.

Early Urban Drainage Systems

When urban development first began, piped drainage systems did not exist. Drainage patterns followed the slope of the land and generally followed the roadways to any low point at streams or a body of water (see **Figure 2.2**). As hard materials began to be used for roadways, gutters were formed to convey flows along a channel to its outlet. The surface runoff carried all of the runoff and anything else that it could wash along. This included street debris, which often had waste materials from households and businesses and could even include privy waste.

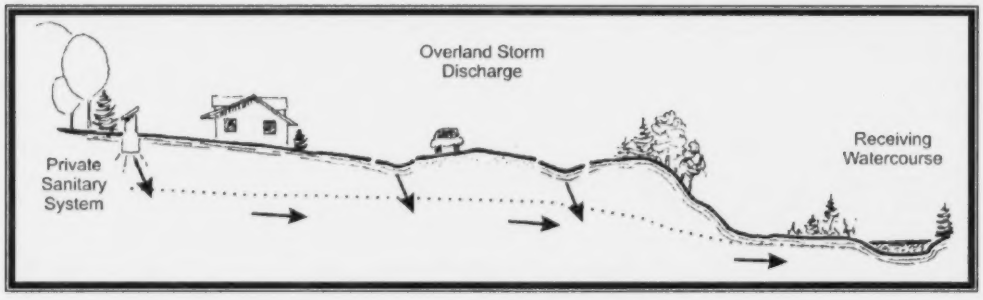


Figure 2.2 - Historic System

Introduction of Piped Drainage

The unsanitary conditions of surface drainage led to the use of pipes to carry drainage underground. The early drainage systems carried all runoff and waste previously disposed of in the streets. The earliest pipes consisted of boards and brick strapped together.

As technology advanced and alternative materials became available (clay, lead, iron) the piping was extended into homes and business to provide drainage from the inside of buildings to the streets.

During this time drainage was combined (see **Figure 2.3**). All storm drainage and waste water was discharged to an outlet point which would have been a stream or lake. This approach reduced problems with waste discharge in surface runoff but transferred the problem to the receiving waters. The impact was not immediately evident, as the relatively small population contributing to the discharge was such that the receiving water bodies could easily assimilate these loadings.

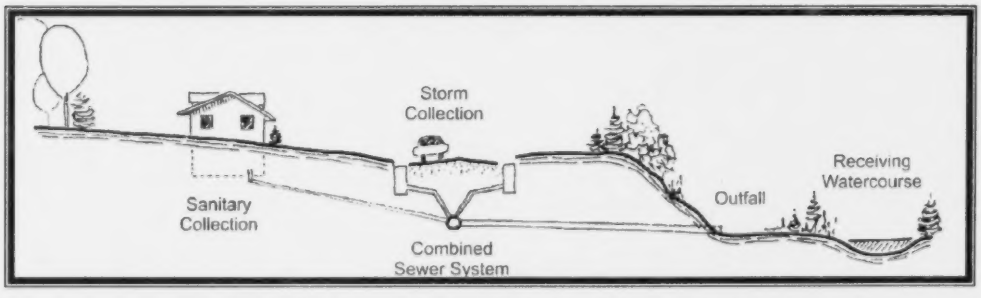


Figure 2.3-Combined Collection with No Treatment

Introduction of Sewage Treatment Plants

As the population increased in 'urban' areas, the problems with the discharge of waste to receiving waters became apparent and sewage treatment plants were introduced (see **Figure 2.4**). These plants were developed to remove pollutants and pathogens. Typically treatment plants are designed to treat low flows that occurred during dry periods and some minor storm events. During larger runoff events, some of this flow bypasses the treatment system and is directly discharged to the receiving water.

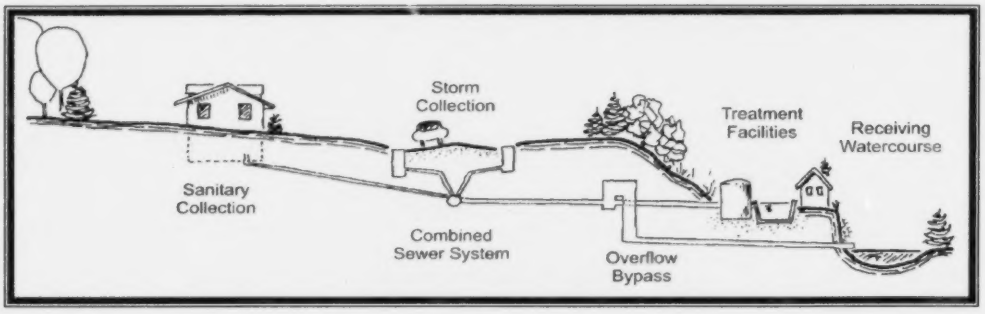


Figure 2.4 - Combined Collection with Treatment

Separation of Sewer Systems

Separate sewer systems, generally constructed since 1956 in Ontario, provide storm sewers for runoff drainage and sanitary sewers for sewage flow. This approach was introduced to avoid the problems of wastewater being flushed into receiving waters during significant runoff events (see **Figure 2.5**).

Although separate sewer systems are in use in newer areas, many municipalities still have combined sewers in the older, dense core areas of the municipalities. Significant pollutant loadings to receiving waters will continue to occur in older municipalities until measures are carried out to provide separated sewer systems or to reduce the flows to the combined sewer or the sewage treatment plant. Increasing the plant capacity is another costly alternative, which may address the problem if sufficient pipe capacity is available to transport the sewage to the sewage treatment facility.

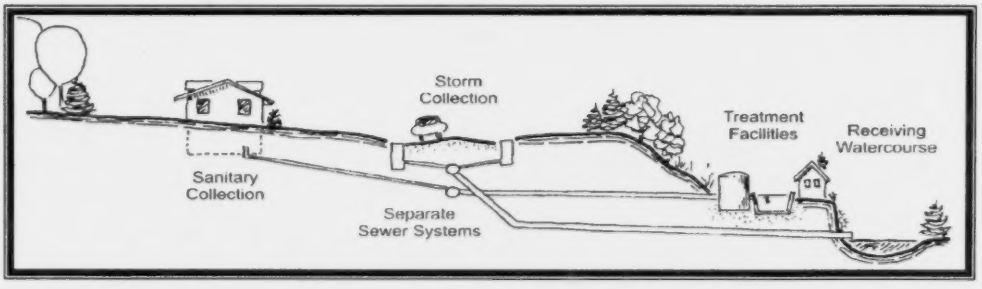


Figure 2.5 - Separate Collection with Sanitary Treatment

Sanitary Sewer Systems

The municipal sewage carried by sanitary sewers consists of domestic, commercial and industrial wastewater, which is carried to a sewage treatment plant. These sources contribute so-called conventional pollutants such as bacteria, organic matter, suspended solids and nutrients, which are treated at sewage treatment plants. In addition, hazardous chemicals from industrial and commercial sites as well as household sources are present in sanitary sewage.

Heavy rain running from roofs and other impermeable surfaces lead to overloading of sewers and can result in the overflow of combined sewers. These combined sewer overflows discharge directly and untreated to the nearest watercourse. Even with sewage treatment, persistent chemicals, such as chlorinated hydrocarbons and heavy metals, are not destroyed but pass through the treatment process into the receiving water or end up in the biosolids. One major use of biosolids is to spread them on agricultural land, but this use is curtailed if metals or other contaminants are present in excessive amounts.

Sewers are sized to handle the normal waste water flows from the usual variety of land uses plus some extraneous flows. This extraneous flow consists of infiltration, which comes from leaks in sewers (groundwater infiltration) and inflow that comes from sources such as foundation drains and household downspouts.

Some areas have abnormally high infiltration and/or inflow, termed I/I, which result in surcharged sanitary sewers during rainfall events. Remedial works to reduce the amount of extraneous flows are often necessary. One of the most effective programs to reduce this I/I is to disconnect downspouts since this can be the largest inflow contribution to a sanitary system.

Poor overland stormwater flow routes can also contribute to extraneous flows during large storms when rainwater enters the sanitary sewer via the manhole frames and covers. If a significant problem exists, mitigation can be provided through changes to overland flow routes by sealing the manhole frames and covers.

Storm Drainage System

Generally flows to a storm sewer system are more difficult to quantify than the flows in a sanitary system. A storm sewer is designed to provide conveyance for a minimum level event so that most of the storms in any given year can be accommodated. Typically this design event ranges from a 1:2 to 1:10 year event (i.e., 1:2 year is the largest event on average every 2 years). During more extreme events, which occur on average less frequently than the design event, the storm sewer system is surcharged and the higher flows are conveyed along the street. If the storm sewer system is connected to foundation drains, this can result in sewer backups and basement flooding.

Since storm sewers can only convey up to a specified event a storm drainage system is designed to provide a minor and major system (see **Figure 2.6**). The minor system (storm sewers) convey the more frequent design events (1:2 to 1:10 year). The major system is comprised of overland flow paths along roadways and open channels to provide safe conveyance of major storm events to nearby stream or river systems. The major event is generally set at a relatively high level to minimize risk to life and property (i.e., 1:100 year, or a recorded major event).

Watercourses within urban areas are often used as part of the conveyance system and suffer impacts due to changes in flows from urbanization. These impacts include higher flood levels, increased erosion and degraded water quality. These impacts ultimately result in the collective degradation of the aquatic ecosystem.

Stormwater management is practised to protect natural waterways and receiving waters from urban impacts. Controls include peak flow control for flood control, peak flow and volume control to mitigate erosion impacts and water quality controls for water quality impacts.

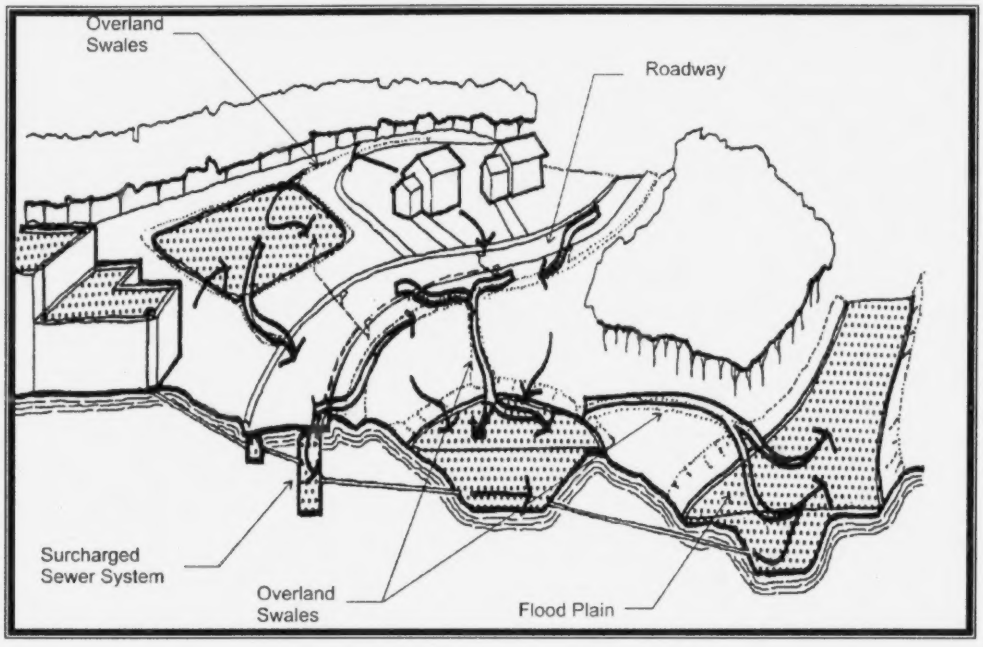


Figure 2.6 - Major Storm Overland Path

2.3 How Do We Solve the Problem?

Pollution prevention is defined as:

> *"The reduction or elimination of pollutants or wastes at the source"* (Reference: MOEE, August 1997, Ontario's Progress in Pollution Prevention).

A broader and more detailed definition of pollution prevention is given below:

> *"The use of processes, practices, materials, products, substances or energy that avoid or minimize the creation of pollutants and waste and reduce the overall risk to the environment or human health" (Reference: Canadian Environmental Protection Act, 1999)*
>
> *"Pollution prevention promotes continuous improvement through operational and behavioural changes. Pollution prevention is a shared responsibility among governments and individuals, industrial, commercial, institutional, and community concerns. It focuses on areas such as:*
>
> - *substances of concern,*
> - *efficient use and conservation of natural resources,*
> - *operating practices,*
> - *clean production practices which create less waste,*
> - *training,*
> - *equipment modifications,*
> - *process changes,*

- *materials and feedstock substitution,*
- *product design and reformulation,*
- *product life cycle,*
- *purchasing practices."*

(Reference: *A Strategy to Fulfil the CCME Commitment to Pollution Prevention*, CCME, May, 1996.)

Pollution prevention provides a means of reducing pollutant loadings resulting in an associated benefit to water quality. Pollution prevention is generally achieved by controlling pollutants at the source so that they do not enter the flow of water (i.e., surface water, streams or sewers). Pollution prevention can also be achieved through the reduction of flows or diverting the flow from the pollutant source. An example of this is the infiltration of stormwater into ground so that less surface water stays on the surface to wash pollutants off lawns or roadways.

The benefits of pollution prevention include:

- minimizing the use or avoiding the creation of pollutants;
- preventing the transfer of pollutants from one medium to another, i.e., reducing air and land pollution;
- minimizing health risks to residents and workers exposed to toxic and hazardous chemicals;
- promoting the development of source reduction technologies and using alternative methods;
- using energy, materials and resources more efficiently;
- reducing future liability for industries, commercial establishments and municipal departments, especially if carried out as part of a formal Environmental Management System;
- recognizing that waste is a cost that can be reduced;
- avoiding costly clean up in the future;
- recognizing water as a resource;
- enhancing the local living environment.

Ways in which flow reduction measures can provide pollution prevention benefits are listed below. Flow reduction benefits depend on the type of sewer system to which the flows were originally being discharged.

- **Reduced site runoff**. Flow captured and utilized on-site through methods such as downspout disconnection, rain barrels, and infiltration all reduce the amount of runoff. This reduces the load of pollutants to surface waters since clean water infiltrated into the ground eventually reaches surface water with reduced contamination.
- **Diverted flows**. Any water diverted from a combined sewer overflow (CSO) will reduce the amount of overflow and result in improved water quality.
- **Reduced control costs**. Any flow reductions to the CSO system or diversions from the combined sewer system will reduce control costs for storage or treatment.

- **Reduced sanitary sewage flows.** Any water conservation method, flow diversion, or sewer I/I reduction that reduces flow to the sanitary sewer and sewage treatment plant (STP) reduces costs including pumping, treatment costs, sludge generation and chemical usage. Pollutant loads to surface waters from the STP will also be reduced, including those contaminants that treatment plants do not remove. In addition, expensive sewage treatment plant expansions can be avoided or delayed, providing additional capacity to handle population growth.
- **Detained flows.** Runoff that is stored temporarily, then discharged back into the combined sewer system in dry weather will avoid CSOs. This will be treated at the sewage treatment plant. Detaining flows in stormwater management ponds provides water quality benefits by reducing sediment loads.
- **Maintain or provide for pre-urban hydrologic conditions.** Reduced flows to storm sewer systems will; lower high flow rates that cause channel erosion and flooding; reduce the potential for flooding caused by storm sewer back-ups; increase the amount of water available to the groundwater system; increase the amount of baseflow in watercourses; and reduce pollutant loadings to local streams and rivers.

There have been many initiatives by both provincial and federal governments in Canada to promote pollution prevention programs:

- The Ontario Ministry of the Environment (MOE) has supported and recognized industrial, commercial and institutional sectors in implementing pollution prevention initiatives in the past and will continue to do so in the future.
- MOE provided support for Pollution Control Planning to control point sources, combined sewer overflows (CSO) and stormwater. The name was changed in the early 1990s to reflect the prevention focus (i.e. Pollution Prevention and Control Plans).
- Ontario CSO Control Procedure F-5-5 (1997) requires that a pollution prevention and control program be established as a component of the minimum CSO controls.
- The Canadian Centre for Pollution Prevention (C2P2) in Sarnia was established by Environment Canada in 1992 to encourage and support pollution prevention programs.
- The MOE and Environment Canada have established several partnerships with industry sectors, with the objective of achieving beyond compliance emissions reductions. The MOE has also produced pollution and resource guides for several industry sectors.

2.4 Sewer System Controls

A variety of control measures have been used in combined, sanitary, and storm sewer systems to control flow and pollution.

Combined Sewers

- partial separation of combined sewers to provide separate storm and sanitary systems;
- storage of combined sewer flows during rainfall events followed by treatment of the excess volume during dry periods at the sewage treatment plant.

Sanitary Sewers

- control of inflows by disconnection of inflow sources (i.e., downspouts, manhole covers);

- control of extraneous infiltration by rehabilitation or replacement of sewers;
- Sewer Use by-law development and enforcement;
- pollution prevention programs;
- sewer system maintenance and operation program.
  - inspection (closed circuit television, CCTV) and repair,
  - sewer flushing,
  - pumping station inspection,
  - emergency response system.

Storm Sewers

- stormwater management to control flows for flood and erosion control:
- stormwater management for water quality control;
- Sewer Use by-law development and enforcement;
- tracing and eliminating illicit discharges (i.e. sanitary discharges to storm sewer);
- pollution prevention programs (e.g. Yellow Fish Road);
- sewer system maintenance and operation program.
  - inspection (closed circuit television, CCTV) and repair;
  - sewer flushing;
  - catchbasin cleaning;
  - spill response program;
  - street sweeping.

2.5 Basis for Action

Many water, sediment, and biota contamination problems are a result of discharges from point and non-point sources. Point sources can include discharges from municipal and industrial treatment plants. Included in the point sources are wet weather discharges from combined, sanitary, and storm sewer overflows, and sewage treatment plant bypasses. Non-point sources include urban and rural (agricultural) runoff.

What triggers the need to carry out a pollution prevention program? The need for a pollution prevention program may arise for different reasons, including:

1. Requirements in Ontario's CSO control procedure (F-5-5) to develop Pollution Prevention and Control Plans.
2. Implementation of Remedial Action Plans (see below).
3. Municipal by-laws, such as a sewer use by-law – see Chapter 4.
4. Watershed protection - planning and implementation- see Chapter 4.
5. A history of repeated infractions under Ontario's environmental legislation.

Requirements of Ontario's CSO Control Procedure

"To meet the goals of this [policy] each municipality or operating authority of a combined sewer system will be expected to develop a Pollution Prevention and Control Plan (PPCP)...An implementation plan should show how the minimum CSO prevention and control requirements and other criteria in this [policy] are being met. The minimum CSO controls consist of the following:

Establish and implement Pollution Prevention programs that focus on pollutant reduction activities at source, e.g., reduced use of potential pollutants like fertilizer and pesticides in parks; public education programs, e.g., anti-littering and illegal dumping of used motor oil and other materials into catchbasins; water conservation to reduce dry weather sanitary flow and hence CSOs; street cleaning to reduce CSO floatables; roof-leader disconnection and installing rain barrels to reduce flows into the sewer system; education/assistance for industries to minimize the use/discharge of pollutants; and enforcement of municipal by-laws or regulations."

Remedial Action Plans (RAPs)

Remedial Action Plans (RAPs) are aimed at restoring beneficial uses to Great Lakes Areas of Concern (AOCs) designations that are assigned by the International Joint Commission. There are 42 AOCs within the Great Lakes Basin; sixteen of these are in Canada. There are fourteen impairments to the beneficial usage of AOCs and they include degradation of benthos, eutrophication causing excessive algal growth, and degradation of fish and wildlife habitat. Some impairments to beneficial uses are partly attributed to urban runoff.

Many of the problems of contamination of water, sediments or biota are a result of discharges from point and non-point sources. Point sources can include discharges from municipal and industrial treatment plants. Included in the point sources are wet weather discharges from storm sewers, combined storm and sanitary sewers (CSOs) and sewage treatment plant bypasses. Non-point sources include urban and rural (agricultural) runoff. Many RAPs call for the implementation of pollution control and prevention plans to control the contamination from urban runoff and sewage.

2.6 Information Sources for Developing Pollution Prevention Initiatives

There are many information sources for pollution prevention initiatives including reports, studies, manuals, and web sites from various organizations and associations. Many of the measures discussed in this handbook have specific references either in the main text (Part I), as part of the Fact Sheets (Part II), or Case Studies (Part III). Some general references and contacts are given in Table 2.2.

Table 2.2 – General Information Sources for Developing Pollution Prevention Initiatives

Reference	Description
Residential and Commercial Source Control Programs to Meet Water Quality Goals, Water Environment Research Foundation, Project 95-IRM-1, 1998. Order at 1-800-666-0206, or through the web site at http://werf.org/docs/publications.html and refer to stock number D72005.	Provides a resource for communities developing wastewater and stormwater pollution prevention programs; describes practices and program ideas for specific sources of pollutants; identifies public education strategies, approaches to different audiences and types of materials developed; and discusses ways to gauge program effectiveness.
California Stormwater Best Management Practices Handbooks, 1993, prepared by Camp Dresser & McKee, et al. Available from Alameda County Public Works Dept. at 510-670-5543.	Separate handbooks for municipal, industrial, commercial, and construction activity. The Municipal Handbook has chapters on how to develop a stormwater management program, Best Management Practice (BMP) selection, source control BMPs, treatment control BMPs, and measuring performance.
Stormwater Management Practices and Design Manual (1994 and updates). Aquafor Beech Ltd. and Marshall Macklin Monaghan for the Ontario Ministry of the Environment.	A planning and design manual for many stormwater control measures, including source control measures discussed in this manual. Includes many examples from Ontario.
Urban Runoff Quality Management, WEF Manual of Practice No. 23, ASCE Manual No. 87, Order at 1-800-666-0206, or through the website at http://www.wef.org/	Design and performance information for a variety of measures, including source controls.
An Evaluation of Roadside Ditches and other Related Stormwater Management Practices-second edition. J.F.Sabourin and Associates (2000). Available from Toronto and Region Conservation Authority, (416) 661-6600. http://www.trca.on.ca/2e.html	Presentation of design and cost information for alternative local street drainage systems, including grassed swales and infiltration. An Excel based selection tool is provided for assessing different methods.
Canadian Centre for Pollution Prevention, internet site: www.c2p2.sarnia.com	Provides pollution prevention training, workshops, information and advisory services. Publications may be ordered from the website.
A Guide to Pollution Prevention for Municipalities, prepared by the Region of Hamilton-Wentworth (now City of Hamilton). Available from internet site: http://c2p2.sarnia.com/	A guidance manual with additional detailed appendices and resource materials are available.
Canadian Pollution Prevention Information Clearing House Website at: www.ec.gc.ca/cppic/solns_e.cfm	Background information on policy and legislation, e.g., *Pollution Prevention – a Federal Strategy for Action.*

Reference	Description
Great Lakes Pollution Prevention Fact Sheets. From US EPA Website. http://www.epa.gov/glnpo/p2/factsh.htm	Fact sheets including the Environment Canada – U.S. EPA Strategy for the Elimination of Toxic Substances and Great Lakes Pollution Prevention Activities.
Yellow Fish Road (Storm Drain Marking Program).Contact: Toronto and Region Conservation Authority at (416)661-6600. Lake Simcoe Region Conservation Authority at (905)895-1281. Credit Valley Conservation at (905)670-1615. Trout Unlimited Canada at 1-800-909-6040.	Yellow Fish Road Programs in the urban communities of the City of Toronto, East Brampton, Vaughan, Richmond Hill, Markham, Pickering, Ajax, Caledon East, Bolton, Nobleton, King City, and Stouffville. For the area north of this jurisdiction (including Aurora, Newmarket, Bradford, Beaverton, and Barrie). For Mississauga, and the Credit River watershed (including Georgetown, Orangeville, and west Brampton). Elsewhere in Canada.
GreenOntario Provincial Strategy. Website www.greenontario.org/strategy/toxics.html	Fact sheets on issues of concern.
CEPA Environmental Registry http://www.ec.gc.ca/CEPA Registry	The CEPA Environmental Registry is a comprehensive source of public information relating to activities under the *Canadian Environmental Protection Act, 1999*. The primary objective of the Environmental Registry is to encourage and support public participation in environmental decision-making.

3 DEVELOPING A POLLUTION PREVENTION PLAN

The approach to starting a pollution prevention plan depends on the group implementing the pollution prevention plan. This section describes pollution prevention action plans that can be used by various groups to address the following groups/community:

- a municipality, i.e., municipal staff at the department or corporate level;
- an industrial or commercial establishment;
- an institutional establishment (schools, universities, hospitals); or
- a broad community or target group/agency or locally based neighbourhood interest group.

An action plan for a specific group/community can include or overlap with that of the other different groups/community, in that common component plans may be used. These component plans, such as Pollution Prevention and Control, Environmental Management Systems and Sewer Use By-law are discussed in Chapter 4.

In developing an action plan, a sequence of specific tasks is typically followed:

1. Define the problem—identify the specific problem to address, e.g., closed beaches as a result of combined sewer overflows.
2. Scope out the Area—define the geographical area to cover in the plan, e.g., watershed, waterfront, neighbourhood, single company – or a jurisdictional area within a municipality's boundary.
3. Set objectives—set objectives related to the problem to be solved, e.g., open the beaches.
4. Set targets—define specific achievable actions numerically, e.g., open the beaches. Most of the time these can be derived from subsequent steps.
5. Develop the plan—collect information, understand the problem, and its causes and effects.
6. Identify alternate solutions and pollution prevention measures—identify various ways of achieving objectives.
7. Develop the implementation plans—apply the recommended solution.
8. Implement the plan.
9. Marketing—educate and elicit support of involved parties such as residents, staff in the municipal department, or industrial staff.
10. Evaluate the success and follow-up the implementation plan—assess the structure, results and barriers encountered. This often involves management decisions.
11. Modify the implementation plan if necessary.

For each level, the type of activity can be broken down as follows:

1. Actions the group can take directly (Do)
2. Actions or resources that can be provided by others (Pull)
3. Actions that can be influenced in other groups (Push)

In considering control options, measures should be chosen that address specific concerns. **Table 3.1** provides some examples of environmental problems or objectives and typical pollution prevention measures (the list is not exhaustive). Fact sheets providing further information on these pollution prevention measures are provided in **Part II**.

Table 3.1 – Sample List of Pollution Prevention Measures

Problem or Objective	Typical Pollution Prevention Measures	Fact Sheets
CSO control	Flow reduction measures Sewer Use by-law enforcement to reduce toxic contaminant load to sanitary sewers (part of the CSO)	FR 1-7 MO-1
Contaminated sediments	All CSO overflow control measures Storm sewer use by-law monitoring and enforcement Pesticide and herbicide reduction program Catchbasin cleaning and street cleaning programs Filter strips and grassed drainage systems	MO, LD MO-1 SP-3, 4 MO-3-5 LD
Closed beaches due to bacteria	Flow reduction for CSO and stormwater Goose/dog litter control (education and by-law enforcement) Dry weather CSO regulator maintenance Storm outfall surveys to locate cross connections	FR SP-8 LD-4 MO-10
Eutrophication from nutrients	CSO control, flow reduction for stormwater Reduced use of fertilizers	FR SP-3, 4
Flooding and channel erosion	Flow reduction measures in storm drainage	FR
Groundwater contamination	Household hazardous waste disposal control program Spill management Limit infiltration measures to residential areas Reduction in use of road salt Soil contamination management Illegal dumping management	SP-2 MO-9 FR MO 2

3.1 General Steps

A recent report prepared for the Water Environment Research Foundation provides a methodology to develop and evaluate pollution prevention programs. The report, *Tools to Measure Control Program Effectiveness* (Larry Walker Associates, WERF Project 98-WSM-2, 1999), provides information on effectiveness measurement for stormwater and wastewater pollution prevention and public education projects, including costs to implement programs. The report describes an overall process for defining a source control program, and also provides several tools for measuring effectiveness. Several detailed case studies are provided.

Suggested steps for developing a source control program are summarized below:

1. **Identify the issue.** Define the issue by:
   - Identifying a pollutant of concern or waste stream;
   - Establishing a baseline by determining pollutant loading or waste stream volume.
2. **Identify and assess sources.** Sources may be identified by monitoring, agency records, or by reviewing the literature relating to the pollutant of concern and its likely sources. Once sources are identified:
   - Determine the significance of each source by estimating its contribution to the total pollutant loading or wastestream volume;
   - Assess the ability to control each source's controllability with respect to the applicable regulations for that source and pollutant (e.g. municipal sewer use by-law, or a provincial or federal regulation).
3. **Determine available control strategies**. To identify possible control strategies for each source:
   - Consider control strategies already in use elsewhere;
   - Review strategies used by other agencies for this source;
   - Brainstorm to come up with new ideas for your situation.
4. **Evaluate and prioritize control strategies**. To determine which control strategies are most likely to achieve measurable results assess the following:
   - Participation – what portion of the targeted audience is likely to make the desired behaviour change?
   - Loading – what portion of the source's total loading will be eliminated if the entire targeted audience makes the desired behaviour change?
   - Cost – how much will it cost the agency to implement the program and how much will it cost the targeted audience?
5. **Establish a goal.** A goal may be set at any point during the development process. The goal is the desired outcome and may be set based on:
   - A reference condition (i.e., the condition that would exist without interference);
   - The reduction necessary to meet a permit limit or other regulatory or environmental standard;
   - A reduction that can be realistically achieved based on the estimated load reductions determined in the previous step (based on the control methods or technologies available);
   - Performance necessary to meet an intermediate goal;
   - Action plan for meeting final goal.
6. **Implement program.** Part of program implementation is selection of an effectiveness measurement tool to assess the program. Before choosing assessment tools, determine what information you are seeking about your program. The tools are then chosen based on:
   - The ability to measure achievement of the goal;
   - The target audience and control strategy chosen;
   - If assessment is necessary during the program or can be deferred until the program is completed;

- What stage the program is focussing on (i.e., increased awareness, behaviour change, environmental improvement).

7. **Evaluate effectiveness.** Based on the effectiveness measurement, the agency determines what it has learned from the program:
   - Has the program's goal been achieved?
   - What were the most effective aspects of the program?
   - What changes are needed to achieve better results?
8. **Modify program.** The results of the effectiveness measurement will help to determine the future direction for the program with respect to:
   - Additional strategies to address this source if the desired results were not achieved;
   - Alternate sources to pursue if no further or limited reductions are possible from the source addressed so far;
   - New issues to pursue if this pollutant or waste stream issue were adequately addressed by this program.

3.2 Municipal Pollution Prevention Planning

Options that a municipality can consider for pollution prevention planning are summarized in **Table 3.2**.

Table 3.2 - Options for Pollution Prevention Planning at the Municipal Level

Municipal Plans		
Municipal Wide	**Local**	**Watershed**
Pollution Prevention and Control Plan	**Implement pollution prevention, flow reduction**	**Watershed Study**
Environmental Management System	**Enforce by-laws in residential areas**	**Regional Action Plan Study**
By-law	**Enforce sewer use by-law for industry**	
Pollution Prevention Plan	**Implement Public Education programs**	
Best Management Practices		
Flow Reduction		
Programs – Air quality, Outfall and Monitoring		

Types of action a municipality can take include:

1. Direct Action

A description of the actions that can be taken are discussed in the following items.

- Develop a Pollution Prevention and Control Plan (PPCP) - if the problem is complex and related to multiple sources such as combined sewer overflows, stormwater and point sources from municipal sewage treatment or industry. Simpler PPCP studies can be developed for stormwater retrofit situations, to narrow the scope of study to stormwater only.
- Develop an Environmental Management System (EMS) - if pollution prevention on a broad scale is desired, and additional benefits are of interest, such as increased environmental performance, improved accountability, and reduced liability for environmental damage. The scope of the EMS can be municipality wide or apply to environmental and works departments or individual facilities.
- Develop a Pollution Prevention Plan (PPP) - if the focus is on a particular source or problem (and the scope of an EMS is too broad). A PPP can apply municipality wide, to departments or to individual facilities.
- Develop a Flow Reduction Plan - this is a type of pollution prevention plan focused on a single problem area, i.e., flows to municipal sewers.
- Develop a water conservation program. This is a component of a flow reduction program, with additional benefits for water supply system capacity and operation costs.
- Update sewer use by-law.
- Develop a community-based social marketing campaign for lot level source control and pollution prevention. This type of program integrates the requirements of the PP and Flow Reduction.

2. Involve Others (Pull)

- Obtain financial and/or technical assistance from provincial and federal resource centres and departments.
- Carry out watershed planning with conservation authorities, or RAP planning with provincial and federal involvement. These overall plans with their broad and specific objectives are particularly useful for providing the context with specific objectives and targets to apply in other plans (such as PP, EMS, flow reduction) into which PP plans can be meshed or integrated.
- Empower neighbourhood groups to apply the principles of PP by – neighbour to neighbour campaigning providing information and resources.

3. Push for Action (Push)

- Push implementation of PP and Flow Reduction plans at the neighbourhood level with delivery and action oriented education for specific programs; assistance for downspout disconnection programs; application of household hazardous wastes collection programs; water conservation.
- Enforce by-laws for residential areas, such as litter and animal control.
- Enforce Sewer Use by-law with active monitoring program, compliance follow-up, and charges when necessary.

- Use the stormwater provisions in the Sewer Use by-law to require industries to carry out Best Management Practices plans, develop PP or EMS plans, and construct stormwater control works.

By-Law Adoption and Modifications

Identify potential by-laws that could address pollution prevention activities, including: sewer use by-laws; downspout disconnection by-law (e.g., St. Catharines); water use/conservation; litter control etc. The City of Toronto's Sewer Use by-law (2000) is an example of a by-law that asks for pollution prevention.

Official Plan Policies

Modifications may be needed to enable pollution prevention and flow reduction measures. Goals of these measures could be identified. Watershed planning requirements for existing areas could be identified as well as RAP targets.

Subdivision Design Policies and Drainage Standards

Modifications may be needed to facilitate pollution prevention and flow reduction measures; stormwater management policy for municipal road and sewer construction projects, and redevelopment projects, e.g., Belleville.

3.3 Industrial / Commercial Planning

Industries and commercial establishments, and institutions can take action for their site or act collectively (**Table 3.3**).

1. Site level actions

- Develop and implement a pollution prevention plan if improved environmental performance is required for the business, or if required by the municipality. Many benefits are derived from these plans, including reduced use of raw materials, reduced waste, energy savings, reduced costs (and increased profits) and improved environmental performance.
- Develop an Environmental Management System - if the increased scope, which includes pollution prevention, and the benefits of improved environmental performance, enhanced image, increased accountability are expected, or if the municipality requires it as a provision of an updated Sewer Use by-law.
- Develop a Best Management Practices Plan - if the problem is mostly related to poor housekeeping and only stormwater is to be controlled, or if the municipality requires a BMP plan as a provision of its Sewer Use by-law.
- Construct stormwater management facilities - if the problem has been defined and pollution prevention or housekeeping measures are not sufficient.

Table 3.3 - Industrial/Commercial Plans

Industrial/Commercial Plans	
Site Plans	**Collective Action**
PP Plan	**Industrial Association**
EMS	**Community**
BMP	**Watershed**
Water Conservation	**Sector**

2. Collective Action

- Set up or join an Industrial Association - these provide a common focus, are useful for attracting resources, and provide a vehicle for peer assistance in carrying out PP, BMP, and EMS development.

Industrial sector-based associations are geared to assist in industry-specific issues, where the materials, equipment and control technologies are unique. Issues such as raw material replacement can be addressed collectively in dealing with the provincial and federal governments.

3.4 Community/Neighbourhood Level SWPP Plans

Community-based groups such as neighbourhood rate payers, service clubs, or environmental interest groups develop and apply stormwater pollution prevention programs (**Figure 3.1**).

Get organized. Identify group goals and membership, especially those willing to contribute time and resources. Choose a leader to drive the program and to be the main contact person.

- Identify the problems or issues to be addressed.
- Contact existing groups for information.
- Contact municipality to determine best fit of issues to actions.

1. **Set scope and objectives.** Is the issue or group interest directed to a local neighbourhood, community-wide or watershed-scale problem? Do you want to address solely residential sources of pollution or all uses such as municipal activities, commercial and industrial operations and institutional sites? Choose something specific as objectives, for example, "Reduce runoff to combined sewers in our neighbourhood", or "Change municipal practices to increase pollution prevention", or "Reduce runoff pollution from industries in our watershed". If a watershed plan already exists, this is a good source of objectives that are already set for your area.

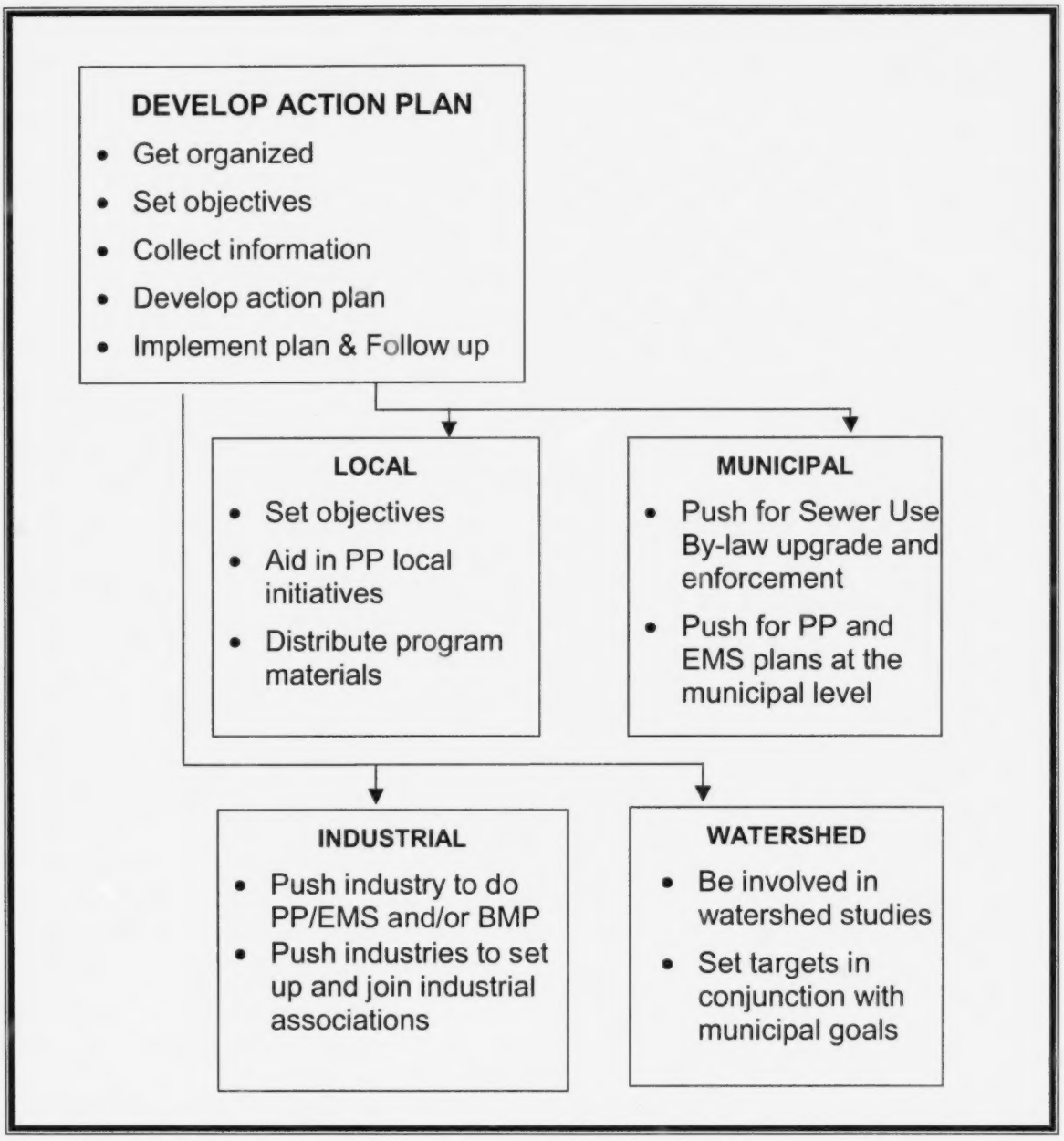

DEVELOP ACTION PLAN
Get organized
Set objectives
Collect information
Develop action plan
Implement plan & Follow up
LOCAL
Set objectives
Aid in PP local initiatives
Distribute program materials
MUNICIPAL
Push for Sewer Use By-law upgrade and enforcement
Push for PP and EMS plans at the municipal level
INDUSTRIAL
Push industry to do PP/EMS and/or BMP
Push industries to set up and join industrial associations
WATERSHED
Be involved in watershed studies
Set targets in conjunction with municipal goals

Figure 3.1-Community-Based Stormwater Pollution Prevention Programs

2. **Gather information.** Once you know your project direction, do some homework on the subject. Use the resources in this Handbook to track down information on the subject or problem. This includes obtaining other handbooks, reviewing Internet web sites, and approaching the municipality for information. Refer to the other sections in this chapter (depending on the scope and objectives adopted for your project) and find out if the measures have been adopted, such as: sewer use by-laws, pollution prevention plans, environmental management systems, watershed plans.

   Contact both federal and provincial government agencies and your municipality to determine what policies and programs exist to address your concerns; what resources (e.g. technical assistance from other groups and government) exist to provide input to policies and programs, and what funding mechanisms exist.

   Find out about pollution sources and effects in your area. This will help to focus your activities and provide support for pollution prevention efforts. Earlier chapters in this handbook can help by showing the general effects of urban runoff. Find out the type of sewer system your area drains to, as this will affect the type of control measures. Monitoring outfalls may be useful for your problem area, but be aware of the costs for lab support and the need to follow strict protocols in taking samples.

3. **Develop an action plan.** Your plan should now be focused on a list of specific actions to help achieve your objectives. Four action plans are discussed below for neighbourhood level, municipality-wide focus, industrial/commercial focus and watershed focus. These are provided as a guide to the type of activity that could be followed. Try to obtain financial support or resources for the plan (see **Tables 3.4** to **3.7**).

4. **Implement the plan.** Carry out the actions in the plan. Develop recommendations for action by other groups. Present the results to industrial groups or the municipality.

5. **Follow up and repeat.** Your group should be prepared to follow-up to monitor the implementation of the plan and repeat some activities if necessary.

Table 3.4 - Action Plan for Local Neighbourhood Group

Target: to get local residents to adopt specific practices for pollution prevention and flow reduction.
Approach:
Decide on control measures e.g. rain barrel and hazardous waste pickup.
Get brochures from municipality
Deliver brochures provided by the municipality door-to-door with a letter from the president of the neighbourhood association.
Group members adopt SWPP practices and talk to neighbours.
Obtain help from the municipality in setting up hazardous household waste pick-up points.
Distribute rain barrels and give instructions.
Follow-up: Report on results to association members with annual letter to residents and municipal councillor. Maintain programs.

Table 3.5 - Action Plan for Municipal-wide Issues

Target: to get municipality to develop and apply Pollution Prevention (PP) program.

Approach:

Review existing programs to see if they are adequate.

Push for sewer-use by-law upgrade to new model by-law distributed by the Ministry of the Environment, and make sure enforcement staff are available.

Push the municipality to use provisions of the sewer-use-by-law to improve industrial and commercial business programs.

Pollution prevention (PP) and Environmental Management System (EMS).

Push for PP and EMS plan development at the municipal level.

Request development of educational materials and technical support to deliver programs to resident groups and individual residents.

Follow-up: Expect reports on progress from the municipality. Attend council meetings and ask questions.

Table 3.6: Action Plan for Industrial, Commercial and Institutional Areas

Target: Control of discharges from industries in your area.

Approach:

Review status of industrial control by talking to the municipality and the industries themselves.

Push industries to voluntarily adopt PP or EMS for their system. A stormwater control program should be adopted if specific problems are known with respect to runoff.

Ask for industrial associations to be formed to provide support for the industries and a focus for interaction with the residents.

Follow-up: Expect progress reports from the industrial associations.

Table 3.7- Action Plan for Watershed Issues

Target: develop and implement a watershed plan in order to provide a focus for PP activities.
Approach:
Push the municipality and conservation authority to develop a subwatershed plan for your area.
Be involved in the plan development by participating in public meetings to set objectives and review plan components and implementation options.
Take on a stewardship role for the watershed and be prepared to assist in plan implementation.
Follow-up: in the stewardship role, be involved in monitoring programs and in distributing educational materials.

3.5 Learning from Experience

Staff from four municipalities of varying sizes (the Town of Ancaster, the Region of Waterloo, the City of St. Catharines, and the City of Toronto) were approached to discuss their experiences in implementing pollution prevention programs. The selection was based on the replies to a questionnaire circulated by the Ministry of the Environment in 1997, and an attempt to provide case studies with a range of community size, structure and responsibilities. The common problems for these municipalities included impacts from overflowing storm sewers upon local waterways or a nearby lake. All of the selected communities had initiated some form of public involvement and education, although this varied widely according to the staff and resources available. All the municipalities had included outreach and partnerships with the industrial, commercial and institutional sectors.

The three largest municipalities also initiated water efficiency and flow reduction measures to deal with problems such as sewer overflow discharges to creeks or a lake, basement flooding and conservation of groundwater supplies. These communities also included a vigorous school program to educate future consumers.

The staff interviewed for the case studies readily provided information about program successes and deficiencies to assist other communities with similar problems. Program successes had in common a strong staff commitment and leadership, policy or by-law support, and a major public education and outreach component with partnership and stewardship actively encouraged. Knowing your community and your target audience was also considered an important factor in implementing a successful program.

Factors considered detrimental to the successful implementation of some programs included:

- lack of co-ordination and designated leadership;
- failure to provide sufficient understandable public information to the target population;
- failure to use community resources such as contractors and suppliers for a toilet replacement program;
- time and effort wasted when communication links failed and a voluntary monitoring was carried out in one area while the program was implemented in another;

- lack of political support for municipally - initiated environmental measures in the face of resident's complaints and preferences.

In all of the case studies municipalities provided a wealth of public information materials such as brochures, fact sheets and newsletters. Costs were minimized where possible by using material already available from other sources or by working in partnership with other agencies or municipalities. For major community-based programs, the media was considered to have a considerable influence on the program acceptance by the public.

Elements identified as strongly contributing to the successful implementation of a pollution prevention program included:

- a strong, long-term municipal staff commitment especially as a leader or co-ordinator;
- sufficient financial resources to provide this support and create/distribute promotional materials;
- a reasonable number of clearly defined objectives that are practical, environmentally sound and attainable;
- policy or by-law support, which also implies strong political support;
- public support fostered by education and some involvement in the program development or implementation;
- recognition and use of community resources, such as the use of community contractors and suppliers where possible to provide services and materials, linkages to watershed studies, management plans and larger scenarios (e.g. RAP) as a basis for justifying the program.

3.6 Evaluating Program Effectiveness

Effectiveness measurement tools include:

- Surveys – quantitative; targeted; phone banking;
- Group feedback – focus groups; workshops;
- Pilot study – to test out an approach;
- Environmental analysis – effluent or receiving water sampling;
- Tracking responses;
- Tracking sales – e.g., hazardous household products and safer alternatives;
- Modelling;
- Cost benefit analysis;
- Inspections and site visits;
- Participation rates;
- Estimated load reductions.

The following influences the selection of the measurement tool:

- Target audience (i.e., business, residential, schools, rural population);
- Timing with respect to project planning (before, during or after a project is conducted);
- Stage with respect to environmental improvement (program implementation, increased awareness, behaviour change, environmental improvement).

Based on the case studies discussed in the report, the effectiveness tools most appropriate to a specific source control are summarized below:

- **Programs targeting business audiences.** Tools commonly used include measurement of participation or compliance rates, discharger sampling, and site visits and inspections. Other tools that have been used successfully include cost-benefit analysis, estimated load reductions, and focus groups. Participation rates are a useful measure when the control strategy used is a recognition or certification program. Discharger or effluent sampling is used most effectively when a specific business category is targeted. Effluent or influent sampling is only an effective indicator of program performance if a single source (i.e., business category) is responsible for the major portion of a pollutant's loading.
- **Programs targeting residential audiences.** Most of the control strategies used for this audience are based on educational outreach materials and methods of advertising this material to the public. Effectiveness measurement tools commonly used include quantitative and targeted surveys, tracking responses, and focus groups. Other tools that have been used effectively when adequate data is available include estimated load reductions, tracking sales, effluent toxicity, and modelling.
- **Assessment during program planning.** The most commonly used tools during the planning process include estimated load reductions, focus groups, modelling and quantitative surveys.
- **Assessment while a program is being conducted.** Certain tools can be used to assess the program while it is underway. These include inspections/site visits and participation rates for business oriented projects, and tracking responses or sales patterns for residential audience projects.
- **Assessment after a project is completed.** Discharger and effluent sampling are conducted to assess the impact of an implemented project that targets a business audience. Targeted surveys are used to assess the impact of an outreach program for the residential sector, specifically with respect to whether workshops or education materials resulted in positive behavioural changes. Quantitative surveys can also be used to assess the impact of residential outreach specifically with respect to the overall impact of an advertising campaign.

The report *Tools to Measure Control Program Effectiveness* (Stock No. D00302) may be ordered from the Water Environment Research Foundation at www.werf.org

4 TOOLS AND RESOURCES FOR DEVELOPING A POLLUTION PREVENTION PLAN

This chapter provides information on action plans/tools that could be used to implement pollution prevention at the municipal, industrial, or community group level including: watershed planning, pollution prevention and control planning, Municipal Environmental Management Systems, Municipal Sewer Use By-Law, Pollution Prevention Planning, Best Management Plans, and Codes of Management Practices.

4.1 Watershed Planning

Watershed planning represents an approach whereby all key stakeholders can come together and share their information and interests regarding water and related land-based resources within a watershed. Options are identified to ensure the long-term protection, management and restoration of important natural features and functions, and a fair allocation of resources. One component of watershed planning is stormwater management planning . Watershed plans are implemented through a variety of tools including;

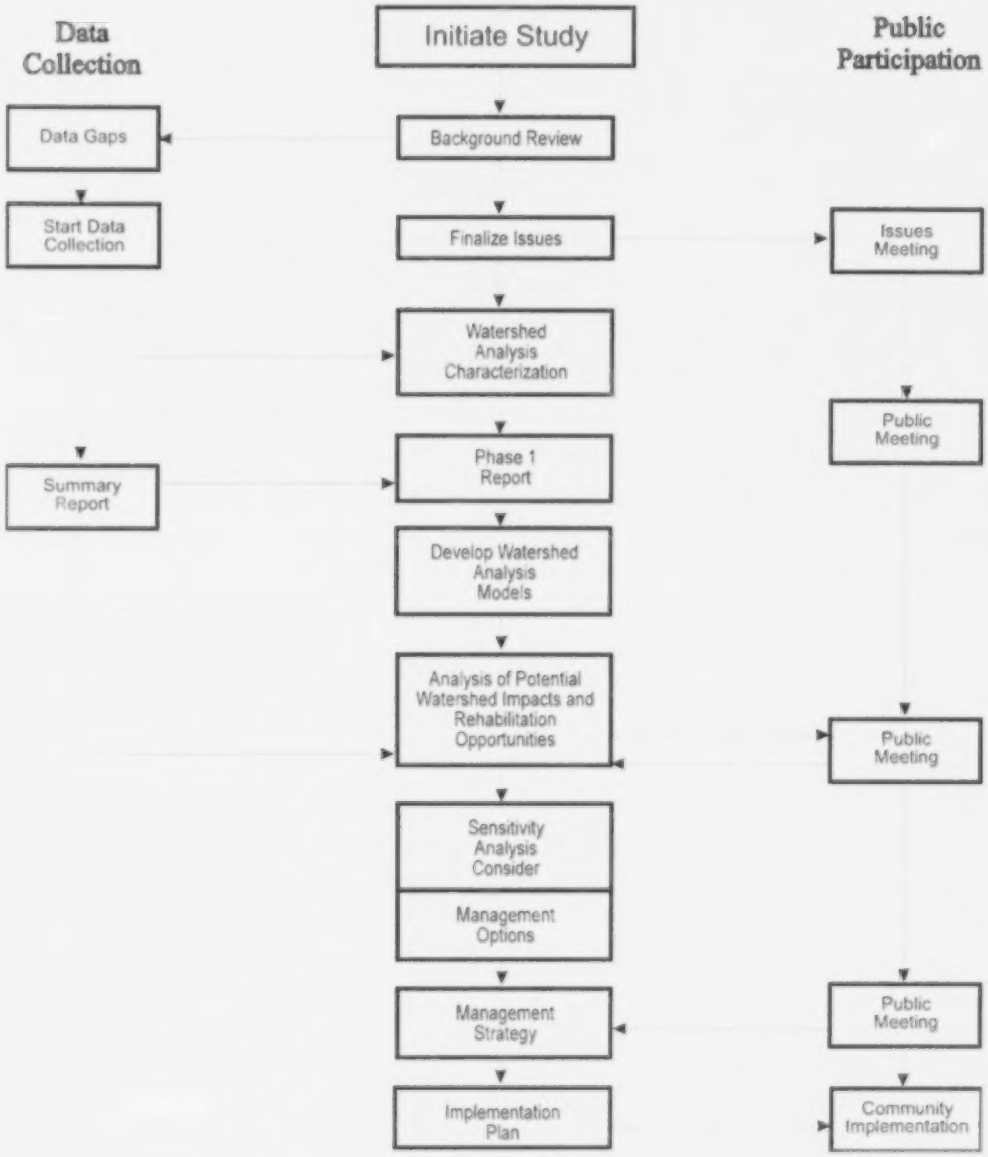
- Land use planning;
- Water and wastewater planning;
- Water use regulations;
- Stewardship programs;
- Land acquisition;
- Infrastructure;
- Remedial programs.

Watershed planning provides the most effective and efficient approach to management by facilitating the understanding of ecological processes and all the interrelationships between watershed features and the processes that occur (function). By developing a deeper understanding of the ecological processes, educated decisions can be made on how to best manage resource use and land use activities.

Assessment of watershed conditions includes identification of sources of pollutants, their transport and deposition and any potential changes in these. Invariably a watershed management scheme includes measures to control pollutants at the source, during transport or at deposition. Pollution prevention measures therefore can be an integral part of a watershed management scheme.

Recognizing watershed planning as the most effective approach to resource management has resulted in many municipalities embracing watershed planning as a part of the land use planning process. **Figure 4.1** outlines a watershed management plan development process.

Figure 4.1
Watershed Management Plan Development Process



The land use standards and servicing standards set using a watershed management approach reflect community needs, ecosystem sustainability and economic needs, and are viewed as the cornerstones of a resource management program. Each element must be considered to provide a management approach that is sustainable.

Watershed planning is used to plan future land use (i.e., new development and retrofit), and watershed regeneration planning, and to determine land use options. It is used to identify watershed features and functions to be protected, and identify any restrictions or changes to land use. A watershed planning approach provides a basis for setting stormwater quantity and quality control targets. It can also apply to surface and groundwater use restrictions (resource management and wastewater discharge standards or criteria).

Key Steps in Watershed Planning

The process followed in watershed planning is outlined in the June 1993 *Water Management on a Watershed Basis*, watershed-planning guidelines published by the Province of Ontario *(Implementing an Ecosystem Approach; Subwatershed Planning;* and *Integrating Water Management Objectives into Municipal Planning Documents).*

The steps include:

1. Developing a general understanding of the watershed or subwatershed.
    - General review of background information for an initial understanding of watershed processes, terrestrial features, streams, geology, land use, and recreation.
2. Working with the community to identify issues, concerns, a vision and goals.
    - Hold information sessions, workshops and public meetings to discuss concerns and develop a list of issues.
    - Hold workshops to develop a vision for the watershed/subwatershed and identify goals and issues to use as a framework in developing a plan.
3. Identifying key watershed processes and linkages.
    - Watershed processes are analysed to characterize the watershed for the key areas of interest such as:
        - surface water, streams,
        - hydrogeology,
        - terrestrial conditions,
        - aquatic habitat,
        - water quality.
4. Evaluating existing land use (and services) and potential changes.
    - Quantify impacts of current land use and potential impact of future land use and servicing changes on the watershed processes.
5. Identifying management needs.
    - Quantify impacts of current land uses and potential impact of future land use and servicing changes on the watershed processes.
6. Setting targets to be met and management objectives.
    - Establish key parameters and related targets to meet watershed goals.

- Determine objectives to be followed in strategy development (source controls, conveyance, end-of-pipe).

7. Developing a management and implementation strategy.
   - Outline key components of management strategy.
   - Develop an implementation plan including public outreach, delivery, monitoring and evaluation plans.

Pollution prevention measures form a key component of both the land use and servicing standards parts in the implementation of watershed plans and retrofit/regeneration strategies and stewardship programs. Some measures (i.e., urban tree planting, park maintenance, and xeric or water conserving landscaping) are integral to land use management strategies aimed at reducing quantity and quality impacts on stormwater runoff. Many measures, referred to previously as 'source controls' and now as 'at source' or 'lot level' control measures (i.e., roof leader disconnection, grassed swales), provide stormwater controls. 'At source' control works are generally recognized as effective stormwater management measures. Pollution prevention measures can also be applied as rehabilitation or retrofit tools that often form a key component of a management strategy. Often the retrofit of existing facilities is necessary to meet the goals and objectives set for the watershed.

The selection and application of pollution prevention measures are carried out in steps 6 and 7 above. Invariably, no single management tool is sufficient to meet all watershed goals. Generally, a selection of measures is required to meet all of the set targets and objectives. Pollution prevention measures that provide at-source control facilities can form an integral part of an overall strategy.

Often the measures selected can be implemented through community stewardship. Measures such as reduced pesticide use, xeric landscaping, tree planting, and roof leader disconnection are all measures that can include community involvement. The Centennial Creek Case Study in Part III provides an example of the development of a sub-watershed based plan that includes pollution prevention measures.

4.2 Pollution Prevention and Control Planning Study

Pollution Prevention and Flow Reduction in a PPCP

A Pollution Prevention and Control Plan (PPCP) is typically initiated by a municipality to address water quality concerns from a variety of sources: combined sewer overflows, stormwater runoff, sewage treatment plant effluents and industrial discharges. Often watersheds draining to, or through, the study area will contain non-point sources such as agricultural activity and road run-off in urban areas. The municipality takes a the lead role in planning and implementation of the study, although subsidies from the Ontario Ministry of the Environment and Environment Canada (for RAP areas) have been provided in the past. The Terms of Reference for a PPCP study usually follow a phased approach with the following steps:

1. Problem definition
2. Objective and target setting
3. Monitoring
4. Analysis of the system

5. Development of potential control options
6. Preferred option
7. Implementation

Guidance in carrying out a Pollution Control Plan is available from the Ministry of the Environment (MOE, 1984, Technical Guidelines for Preparing a Pollution Control Plan). However, this document does not outline pollution prevention measures.

The municipality should ensure that the terms of reference are detailed enough that pollution prevention factors are included. A Pollution Prevention and Control Plan is an ideal opportunity to analyse structural and non-structural/preventative measures concurrently. Most quantitative analysis tools (models) can handle flow reduction measures, as long as sufficient detail is allowed for lot-level factors such as percent imperviousness, and accounting for roof, sidewalk and driveway drainage. Minor modifications to existing models may be necessary to account for infiltration measures and some other flow reduction measures. On the other hand, the ability to quantitatively account for many of the pollution prevention measures is limited, primarily because little information is available on performance factors.

Table 4.1 outlines the factors considered in a typical pollution control planning study, compared to the additional factors that would be considered in a pollution *prevention* and control study.

Table 4.1 - Pollution Prevention and Control Plan Factors

Study Activity	Factors considered in Pollution Control Planning Study	Additional Factors considered in Pollution Prevention and Control Planning Study
Problem definition	Scope issues. Specific problems defined such as CSOs, beach closures, basement flooding, channel protection from flooding and erosion.	Recognize initially that pollution prevention is to be an integral part of the study; ensure that degraded natural systems are seen as problem to be addressed.
Objective and target setting	Specific targets for problems set such as: Meet MOE policy objective for CSO of 90% volumetric control; Protect beaches; Control (store) specific storm event for downstream flood and channel erosion control.	Ensure pollution prevention and flow reduction objectives are included, such as: Control maximum amounts of flow at source; Pollution prevention is to be preferred over control at end-of-pipe.
Monitoring	Measure flow and pollutants at outfalls; Define sewer network; Define receiving water impact; Inventory sewer network.	Review operational programs such as road salting, street and catchbasin cleaning, municipal practices for grass management, sewer use by-law enforcement; Monitor storm sewers in dry weather for sanitary and industrial/commercial cross connections.
Analysis of the system	Utilize rainfall runoff model linked to sewer system model to analyse storage and treatment options.	Ensure rainfall runoff model includes features that allow lot-level controls, such as downspout disconnection, and infiltration measures.
Development of potential control options	Combinations of storage, treatment, sewer separation.	Flow reduction at source, pollution prevention measures.
Preferred option	Low cost option that meets objectives, consider other environmental effects.	Ensure maximum PP and flow reduction at source. Choose programs acceptable to public.
Implementation	Project timing. Capital budgets.	Education programs, regulatory changes, EMS initiation, operation and planning budgets.

As shown in **Table 4.2**, PPCPs have been completed in many Ontario municipalities. The PPCPs for Belleville, Trenton and the Severn Sound municipalities deal with stormwater only since there are no CSOs in these municipalities. STP effluents are of concern for Cornwall, Thunder Bay and Windsor, since these municipalities provide only a primary treatment level for their sewage.

Table 4.2 - Pollution Prevention and Control Plans

Municipality	Area of Concern/Watershed
Thunder Bay	Thunder Bay – Lake Superior
Sault Ste. Marie	St. Mary's River - Lake Huron
Penetanguishene, Midland	Severn Sound
City of Sarnia	St. Clair River
City of Windsor	Detroit River
City of London	Thames River
City of St. Catharines	Lake Ontario
City of Hamilton	Hamilton Harbour – Lake Ontario
City of Toronto – Wet Weather Flow Management Master Plan underway	Toronto Waterfront
City of Belleville, City of Trenton	Bay of Quinte
City of Peterborough	Otonabee River (Trent River)
City of Kingston	Lake Ontario
City of Cornwall	St. Lawrence River

Beneficial use impairment attributed to municipal effluents and addressed by the Plans include:

- degradation of benthos due to accumulation of heavy metals and organic chemicals in bottom sediments;
- degradation of aesthetics caused by algae and floatables;
- negative impact to fish and wildlife habitat (e.g., fish advisories, and poor aquatic habitat);
- limitations on recreational use of the receiving waters (e.g., beach postings and fish consumption limits).

Case studies are presented in Part III for the City of Hamilton and the City of Belleville.

4.3 Municipal Environmental Management System (EMS)

An EMS is a commitment to manage environmental affairs of an organization. The International Organization for Standardization provides a formal standard for what constitutes an EMS. The standard ISO 14001 "Environmental Management System—Specification with Guidance for Use" is a widely accepted standard.

In general the procedures are to be documented. Certification with the standard by an outside group is optional and the performance of the management system can be audited. The point is that the process is accountable and that proof of performance of the management system can be established.

What are ISO, ISO 14000, and ISO 14001?

ISO stands for the International Organization for Standardization, located in Geneva, Switzerland. ISO promotes the development and implementation of voluntary international standards, mostly for particular products but with recent initiatives toward Quality (ISO 9000) and Environmental Management Systems (ISO 14000). ISO 14000 refers to a series of voluntary standards in the environmental field. Included in the ISO 14000 series are the ISO 14001 EMS Standard and other standards in fields such as environmental auditing, environmental performance evaluation, environmental labelling, and life-cycle assessment.

Steps in the ISO 14000 Procedures:

- General Requirements
- Environmental Policy
- Planning
- Implementation and Operation
- Checking and Corrective Action
- Management Review

Canadian municipal experiences with EMSs are limited to a few examples:

1. The City of Hamilton is developing an EMS for its Environmental Department – see case study in Part III.
2. The Region of Waterloo developed an EMS for its Waste Management Operations. Cost for the three year period of development to registration (obtained in 1999) include: one full time co-ordinator; two part time support staff (15%); $10,000 for training; in house costs for printing materials; registration audit $21,000.
3. Toronto is developing EMSs for three facilities as a pilot before considering EMS on a larger scale.
4. The Lakeview Water Treatment Plant in Peel Region, operated by the Ontario Clean Water Agency, has completed the development of an EMS and received its ISO14001 registration.
5. Additional details on a municipal EMS are provided below.

What must a municipality do to have an EMS that meets the ISO 14001 standard?

The ISO 14001 standard requires that a community or organization put in place and implement a series of practices and procedures that, when taken together, result in an environmental management system. ISO 14001 is not a technical standard and as such does not in any way replace technical requirements embodied in statutes or regulations. It also does not set prescribed standards of performance for organizations. The major requirements of an EMS under ISO 14001 include:

- A policy statement that includes commitments to prevention of pollution, continual improvement of the EMS leading to improvements in overall environmental performance, and compliance with all applicable statutory and regulatory requirements.
- Identification of all aspects of the community or organization's activities, products, and services that could have a significant impact on the environment, including those that are not regulated.
- Establishing the management system which links back to the commitments established in the community or organization's policy (i.e., prevention of pollution, continual improvement, and compliance).
- Implementing the EMS to meet these objectives, including training of employees, establishing work instructions and practices, and establishing the metrics by which the objectives and targets will be measured.
- Establishing a program to periodically audit the operation of the EMS.
- Checking and taking corrective and preventive actions when deviations from the EMS occur, including periodically evaluating the organization's compliance with applicable regulatory requirements.
- Undertaking periodic reviews of the EMS by top management to ensure its continuing performance and making adjustments to it, as necessary.

Is an EMS under ISO 14001 relevant to municipalities?

Yes. Because ISO 14001 is essentially a system designed to help communities and other types of organizations meet their environmental obligations and reduce the impact of their operations on the environment, it is relevant to all types of organizations. Counties, municipalities, towns, townships and conservation authorities typically oversee a number of separate facilities and operations. EMSs can be used as a framework to help these operations improve their environmental performance and make greater use of pollution prevention approaches.

What are some of the potential benefits of an EMS based on ISO 14001?

- Improvements in overall environmental performance and compliance;
- Provides a framework for using pollution prevention practices to meet EMS objectives;
- Increased efficiency and potential cost savings when managing environmental obligations;
- Promotes predictability and consistency in managing the environment;
- More effective targeting of scarce environmental management resources;
- Enhances position with the public;

- Sets a good example for industries and commercial businesses to follow in managing their environmental concerns;
- Improves employee safety, and reduces the liability associated with the management of hazardous materials and wastes.

Can existing environmental management activities be integrated into the EMS under ISO 14001?

Yes. The standard is flexible and does not require organizations to necessarily "retool" their existing activities. The standard establishes a management framework by which an organization's impacts on the environment can be systematically identified and reduced. For example, many organizations, including counties and municipalities, have active and effective pollution prevention activities underway. These could be incorporated into the overall EMS under ISO 14001. (Reference: EPA Office of Water, Fact Sheet on Web site www.epa.gov).

ISO 14000 Guidance Document for a Business Community

An example of an Ontario-based resource material for an ISO 14000 tailored for environmental protection is found in the ISO 14000 Guidance Document for a Business Community, Queen's Printer for Ontario, October 1998. This document was prepared for the Ontario Ministry of the Environment and the Emery Creek Environmental Association by the Canadian Centre for Pollution Prevention.

The Guidance Document (GD) is tailored to small and medium sized businesses in the Emery Creek Environmental Association, but can be used by any business of a similar size. It helps to focus activities especially if the businesses are organized in an industrial association with common environmental concerns and a goal to improve a local watercourse or the environment in general.

The GD assists these businesses to learn about the usefulness of the ISO 14000 Environmental Management System (EMS) in addressing their common environmental challenges. The document features include:

- Answers in simple language to some of the commonly-asked questions about EMSs and ISO 14000, and why a company should establish an EMS for its business.
- Hands-on workbook format with checklists, simple flow diagrams and pull-out tables make the document user friendly.
- Builds on a company's existing EMS and on user's previous knowledge.
- Can be used as a first-step introductory guide or a source of references for more advanced learning and implementation for self-certification. The user has a choice; do it yourself, get involved in a group, or, if required, get external help. It informs the user where to get professional help for speedy implementation, and how to make use of outside services in the most cost-effective manner.
- Examples of successful solutions to environmental problems as provided by local businesses are included.
- Lists performance indicators for evaluating a company's environmental management.

Benefits to industry include:

- The ISO 14000 or equivalent EMS helps a company to identify opportunities for resource conservation, cost savings, efficiency and productivity.
- The exercise of reviewing, analyzing, formulating and implementing environmental policy procedures and practices required for an EMS will raise a company's awareness of the impact of its operations and products on the environment.
- Conforming to regulations is facilitated and the cost of compliance is reduced as potentially risky situations are recognized and reduced.
- Annual reviews and audits render efficiency and productivity improvements as an ongoing exercise.
- A company's environmental responsibility can be more easily demonstrated.
- A good corporate image and reputation with the public, community groups, investors, bankers, insurance companies, and regulatory authorities are created.
- Clear lines of environmental accountability and responsibility within a company's organization can be created.

A sample environmental policy, from the document, is shown on the following page.

Sample Environmental Policy

With this declaration *Company XXX* publicly recognizes and commits to conducting its business in full awareness of its obligations to the environment. The company understands that it must provide a positive attitude towards compliance with regulatory requirements that govern its industry, minimize risks to adverse effects from its operations and share this responsibility of stewardship with employees, customers, shareholders and the community. In recognition of this responsibility the company will:

1. Endeavor to ensure familiarity with industry standards and compliance with all pertinent federal, provincial and municipal regulatory requirements.
2. Encourage suppliers, agents and distributors to pursue sound environmental practices and programs.
3. Ensure that all employees are aware of their environmental responsibilities and that they are appropriately trained, involved and motivated.
4. Minimize environmental, health and safety risks, conserve energy and natural resources and minimize waste of all kinds.
5. Commit sufficient resources to allow for the proper implementation of efforts and programs to achieve environmental goals.

We wish to promote and challenge everyone in this global community to join us and adopt these statements as basic elements of their responsibility to their respective community and our planet.

_____ _____

President Date

The guidance document can be obtained from:

The Emery Creek Environmental Association, 857 Fenmar Drive, Weston, Ontario, M9L 1C8, Tel: (416) 749-6373. E-mail: emery@interlog.com

Canadian Centre for Pollution Prevention, 100 Charlotte St. Sarnia, Ontario, N7T 4R2. Tel: (519) 337-3423, Fax: (519) 337-3486, E-mail: c2p2@sarnia.com

Information Officer, Environmental Partnerships Branch, MOE, 40 St. Clair Ave. W. Toronto, Ontario. Tel: 416 327-7721.

4.4 Municipal Sewer Use By-Laws

Many municipalities in Ontario have sewer use by-laws to control discharges to municipal sewers (storm, sanitary, and combined sewers). The *Municipal Act* provides municipalities with the authority to enact by-laws for "prohibiting, regulating and inspecting the discharge of any gaseous, liquid or solid matter into land drainage works, private branch drains and connections to any sewer, sewer system or sewage works for the carrying away of domestic sewage or industrial wastes or both, whether connected to a treatment works or not".

Each municipality must evaluate their operational system and discharges to system in order to establish requirements that control the environmental impacts of these discharges. Local municipal sewer use by-laws can be an effective tool to encourage industries and commercial facilities to prevent pollution because they can:

- prohibit discharges of hazardous waste;
- specify numerical discharge limits e.g., metals, organics, suspended solids, and biological oxygen demand.

Sampling, enforcement, and education play an important role in an effective sewer use control program. Sewer use programs can encourage pollution prevention by increasing awareness of pollutants of concern as well as providing incentives to control discharges and avoid penalties.

City of Toronto Municipal Sewer Use By-Law Example

The City of Toronto adopted a by-law in 2000 to regulate the discharge of sewage and land drainage to municipal sewer systems. This by-law (No. 457-2000) includes different limits for discharge to sanitary and combined sewers, and for storm sewers as well as a specific requirement for pollution prevention planning.

4.5 Sewer Systems, Pollution Prevention, and Management Practices

Pollution prevention planning, best management plans, codes of management practice and environmental management systems can be used as management tools for municipalities and dischargers and can lead to enhanced environmental performance. These tools are often used to complement or enhance quantitative sewer use controls (i.e., discharge limits).

Pollution Prevention Planning (P2)

The term pollution prevention reflects the philosophy that, from both an environmental and a business perspective, prevention is better than cure. In practice this means trying to avoid the costs and risks associated with managing wastes, by not producing wastes in the first place.

Pollution prevention can be achieved by material substitution, product changes, process changes and operational practices. Pollution prevention could be applied to individual specific sites, specific industrial groups or commercial sectors, or all dischargers in a municipality. Approaches for developing a pollution prevention plan are described in Chapter 3.

For example, as part of their sewer use by-law and program, the City of Toronto requires subject sector industries to prepare a pollution prevention plan and submit summaries of the plan to the City. A pollution prevention plan is defined as a detailed six-year plan that identifies operations or activities of an owner or operator of commercial, institutional or industrial premises identifying specific pollution prevention methods. The plan must include a description of pollution prevention options for subject pollutants with a list of possible three year and six year targets to reduce or eliminate the discharge of subject pollutants to the City's sewers. The subject pollutants list includes arsenic and heavy metals, and organic chemicals including pesticides.

Best Management Practices (BMPs) Plans

Best Management Practices Plans (BMPs) are used as a qualitative tool for protecting the environment beyond, or in addition to limits contained in sewer use by-laws. They are designed to reduce the impact of accidental spills or the release of contaminants that are associated with, or ancillary to, industrial manufacturing processes and are generally applied to stormwater control.

A Best Management Plan is generally applied to an individual site. Application of BMPs to all sites in a specific industrial group or commercial sectors, or to all dischargers in a municipality is not usually recommended due to site-specific nature of operations.

The essential components of a BMP plan include: identification and assessment of risk; emergency response plans; reporting of incidents; materials compatibility; good housekeeping; preventative maintenance; inspections and records; security; and employee training. Guidance on developing a BMP Plan may be obtained through the Canadian Centre for Pollution Prevention (http://www.c2p2online.com/) or the USEPA (http://www.epa.gov/).

Codes of Management Practice (CMPs)

A Code of Management Practice (CMP) is a management tool for protecting the environment. CMPs provide a framework for identifying activities that a discharger could undertake to prevent the discharge of harmful substances to the environment, (See Part III Case Studies).

CMPs may be applied to specific industrial groups or commercial sectors. Code of Management Practices by design generally cannot be applied to all dischargers in a municipality unless a CMP is available for each industrial group discharging to the municipality's sewer system.

Environmental Management Systems (EMS)

An Environmental Management System is a management framework for corporate-wide implementation of environmental policies resulting in a high level of environmental performance, (see section 4.3).

The implementation of ISO 14000 by a discharger is voluntary and the status and completeness of the ISO 14000 certification at a discharger's site is verified by auditors approved by the International Standards Organization. Municipalities can also become certified under ISO 14000 for various facets of their operation such as water treatment and supply and sewage collection and treatment.

4.6 Linkages to Other Chapters

This chapter provided municipalities with an overview, and information on different approaches available for pollution prevention. Implementation of these approaches requires technical guidance on pollution control measures (e.g. flow reduction measures, source control of pollutants). Part II of this handbook provides fact sheets on pollution prevention at source, flow reduction at lot level, municipal operations measures, and local drainage and inlets. In Part III of the handbook, case studies of Ontario municipalities are highlighted and practical information on implementing a pollution prevention program is provided. In addition, implementation of pollution prevention measures also requires public support. Chapter 5 offers guidance on garnering support to ensure the successful implementation of pollution prevention programs.

5 BUILDING SUPPORT FOR YOUR PROGRAM AND TAKING ACTION

5.1 Public Outreach and Education

Public education has a significant role to play in pollution prevention because an enlightened and concerned public has the power to alter behaviour at all levels. Pollution prevention and stormwater management initiatives must be understood and supported by the public. If they are not clearly understood, such programs may be viewed as an unnecessary extra cost or a restriction of freedom. Public pressure or even apathy may prevent their successful implementation. **Figure 5.1**, outlines the some of the key roles of public education.

Gaining public support is a continuous process and is often the most neglected phase of solving municipal stormwater pollution problems. Few municipalities have good public information or community relations programs as an integral part of their operations, often because of a lack of funding and staff time.

Role of Public Education

Inform the public about:

- issues
- solutions
- regulations
- financing

Involve the public:

- in remedial action
- in cost saving through volunteerism
- to increase political support

Figure 5.1-Role of Public Education

Schools

Long-range pollution prevention goals can be addressed through school programs, which teach the connectivity between the individual, the land, and the health of the local watercourses. Educating future householders from their early years can positively influence future behaviour in household waste disposal, water conservation and responsible neighbourhood stewardship.

Curriculum-based classroom programs are usually welcomed by local school boards, and may also be designed with the cooperation of local educators.

Community

Short-term goals may be achieved through community outreach programs designed for the general public. These can include projects such as reducing stormwater volumes through downspout disconnection, and the reduction of household chemicals, pet wastes and other pollutants entering storm sewers. Neighbourhood or environmental groups looking for community improvement projects can often provide valuable support. Opportunities arising from news media coverage and publicity of local events can also be used to advantage. Pollution Prevention Best Management Practices displays and presentations can be included as part of municipal events such as the St. Catharines City Open House or beach Clean-Up days.

Business

The commercial sector is a large and diffuse group in many municipalities. Both the business owners/managers and their staff need to be included in any communication activity. Methods of communication may include news announcements in the local press, mailed news items, individual contact and follow-up contacts to answer questions and educate new employees. Public education can also benefit from failures reported in the local press, such as violation of regulations, which results in a citation or fine. This not only informs the reader about regulations but also provides an incentive for the regulations to be followed. An ongoing industrial pollution prevention program is an important part of the Region of Waterloo's Groundwater Protection Strategy, with the focus on active involvement and leadership from the commercial sector itself.

Public officials, governmental institutions and municipal departments should also be informed of pollution prevention programs and their implications. Examples include road, sanitation and parks departments, and workers at public institutions such as hospitals and prisons.

References

Yes In My Backyard (1992). Laurie Fretz. While primarily a guide to rehabilitating urban streams, this manual provides a layman's overview of the issues and problems of urban stormwater management and the impact of pollution on local waterways. Contact the Conservation Council of Ontario. Suite 506, 489 College Street, Toronto, ON M6G 1A5.

Recipes for Clean Water – A Homeowner's Stormwater Survival Guide (1999). William and Judy Beaudrou. Brule Publishing, P. O. Box 641, 3010 Hennepin Ave. S., Minneapolis, MN 55408.

Further information on describing the stormwater management program to the public can be found in *Designing an Effective Communication Program: A Blueprint for Success* (Beech and Dake 1992), and *Urban Runoff Management Information/Education Products* (EPA 1993).

Key Messages for Public Pollution Prevention Programs

In 1998, the Water Environment Research Foundation produced a report, *Residential and Commercial Source Control Programs to Meet Water Quality Goals (Project 95-IRM-1)*, summarizing a literature assessment of wastewater and stormwater pollution prevention and public education programs to address non-industrial sources. The study was specific to the United States,

using information from the ten regions of the United States Environmental Protection Agency. In their Final Report on Source Control some important observations are made that are also appropriate to Canadian communities and reinforce material and information reviewed during the preparation of this manual.

The Report states that typical programs and public education material focussed on educating the public that, as individuals, e0rl are the non-point sources contributing daily to significant water pollution problems. The authors note that materials usually stressed that protection and future enjoyment of local water bodies depend on individual effort to reduce their share of the pollutant load. Most educational materials listed activities that people could do to reduce pollutants. The most exciting materials key into local interests and use regionally appropriate graphics.

The Report summarizes the key public education messages as follows:

- Stormwater and urban runoff are not generally treated; therefore, as these surface flows reach local bodies of water, they contain all of the pollutants that accumulate from everyday living and commerce.
- By making changes in daily habits, individuals can protect the health of local creeks, streams, rivers, lakes, bays and oceans.

The Report notes that messages addressing specific sources of stormwater pollution include:

- Educating the public that specific sources of stormwater pollution include automobile products, vehicle maintenance operations, litter, pet wastes, pesticides, fertilizer, erosion from construction sites and illegal sewer connections.
- These pollutants enter the storm drain as water from rainfall, overwatering or cleaning operations washes over outdoor surfaces.
- Specific outreach messages to business and/or groups typically revolve around encouraging the business to implement BMPs for their particular activity.

The three most commonly used messages related to wastewater pollution prevention inside homes and businesses are:

1. To protect local bodies of water, it is important to avoid pouring toxic chemicals down drains leading to the sanitary and storm sewer system.
2. Alternative products can readily replace household products that are toxic to the environment.
3. There are properly designed and controlled facilities to safely dispose of household hazardous waste in most areas of the country. The public is usually provided with telephone numbers and other information necessary to make arrangements to properly dispose of common toxic wastes.

Developing a Public Education Program

Figure 5.2, illustrates the major steps in developing a public education program and are further discussed below.

STEPS TO A PUBLIC EDUCATION PROGRAM

1. **Define the issues**
2. **Set objectives**
3. **Identify resources**
4. **Outline tasks and conduct activities**
5. **Evaluate the results**

Figure 5.2: Steps to a Public Education Program

1. **Define the issues**. The public must be aware of the problem in terms of its ecosystem impact, the individual community's responsibility and role as the source of concern, and the regulatory and financial issues involved. The education program must tell the public and clearly outline the options open to the municipality to address the specific issues and how much each costs. Public concerns and questions can be identified through surveys, interviews and public meetings and addressed appropriately.
2. **Set objectives**. The objectives of the public education program are to inform and educate the stakeholders and the public at large about a specific issue. It is important to seek input and involve them in the establishment of a citizen task force. Consensus and support for a stormwater management program is an important goal for the public education program, as well as monitoring the effectiveness of the public outreach through follow-up surveys and other means.
3. **Identify resources.** Available resources can include public, staff, a citizen's task force, educational institutions, partnerships with government agencies and community associations.
4. **Outline tasks and conduct activities**. Important elements of some successful public education programs include:
    - Involving a citizen's task force early in the program.
    - Developing appropriate promotional materials such as brochures and flyers.
    - Providing a telephone 'hot line' or website to provide specific information and respond to queries.
    - Conducting surveys.
    - Producing newsletters.
    - Working with the media.
    - Developing presentation materials, i.e., slide shows, displays, videos, and demonstrations.
    - Making community presentations, including neighbourhood associations and business groups.
    - Sponsoring special events.
    - Holding public hearings.
    - Keeping records of public complaints and concerns.

5. **Evaluate results**. Unfortunately there is often no quantified measure or documented record of the direct improvement achieved by public education and it is difficult, if not impossible, to evaluate the effect of school programs on the behaviour of future citizens. However, there is little question of the value of public education in pollution prevention and stormwater management programs.

   Records of the number of individuals participating in a specific program such as Downspout Disconnection provide a measure of the success of an outreach program. A monitoring program or some form of evaluation should be included in the program design if this is feasible. Progress towards or achievement of targets will indicate success in the implementation of remediation measures.

   Monitoring the effectiveness of the promotional material in reaching the desired target groups may be achieved though informal surveys, possibly conducted by students or volunteers, using a "have you heard of?" approach. A "hot line" can also be used to help measure the success of an outreach program.

Developing Best Management Practices for the Public

Development and promotion of Best Management Practices for householders, businesses or schools makes it easier for individuals to take positive and clearly defined actions that have a beneficial impact on their environment. BMP promotion literature can be regional in appeal or focus on specific sites such as the house, garden or neighbourhood, and specific actions such as proper hazardous waste disposal, reduction of garden chemical use or rainwater management.

The information material should provide not only an explanation of the connectivity of the individual's actions with the source of pollution, but a workable remedy for the situation. BMP and explanatory materials can be effectively distributed in neighbourhoods where initiatives such as Stormwater Drain Marking (Yellow Fish Road), Stoop and Scoop pet waste programs, are taking place. For reference see Fact Sheets S.P. 8, and 9, and the City of St. Catharines Case Study.

5.2 What is Social Marketing?

Community-based social marketing is the strategic influencing of ideas and permanent behaviour in a community or a chosen target group. Using methods based on those of commercial marketers, a demand is created for the idea and for the solution to the problem which benefits the target group and society in general.

Social marketing includes:

- creating awareness in the community of the problem and the attainable solution;
- developing community interest in the project;
- promoting the desire to participate; and
- sparking action in the target group or in key representatives of that group.

Specific information on community-based social marketing techniques can be found in the publication *Promoting a Sustainable Future: An Introduction to Community-Based Social Marketing* by Douglas McKenzie-Mohr, published by the National Round Table on the Environment and the Economy.

Social Marketing and Pollution Prevention

Social marketing is used by municipalities to promote stormwater pollution prevention actions. These include actions such as the mandatory downspout disconnection program in St. Catharines and the voluntary disconnection program in the City of Toronto. Mandatory programs are more readily accepted and supported by the public if the social and private benefits, the process and the costs are clearly presented and understood. Some municipalities, such as the Region of Waterloo, use social marketing as a means of public education to influence behaviour in such areas as the use and disposal of household chemicals, or vehicle use reduction (e.g., Bike to Work Day civic promotions).

Steps to Successful Social Marketing

Follow the leader

A committed leader is a key component of a successful program. All the case studies reviewed for this manual indicate that a crucial element for success is strong municipal support and dedicated, long-term staff time. Volunteers may provide co-ordination and leadership in some areas but burnout is common and involvement is generally on a part time or short-term basis.

Know your audience

Identifying and learning about the group you seek to influence is an important step. Your target may be a whole community or just one segment of that community. Community profiles are useful tools to develop for many municipal initiatives. Profiles include population demographics, favoured media, influential community leaders and groups, and popular venues like malls and libraries. St. Catharines' city staff indicated that a previously completed community profile provided an invaluable tool during the development of their stormwater management programs, especially for guidance in the most useful venues for communication.

Strong community support is essential for the successful adoption of a voluntary program. Interviews, focus groups and questionnaires can be used to identify the perceptions of a target group regarding the value of the product or idea, the benefits of behaviour change, the amount of effort needed to participate and the physical or social barriers to implementing the program.

Do not reinvent the wheel

Researching and adapting available studies and materials saves time and money. A great deal of relevant material is already available from university libraries, government agencies, local non-profit organizations, river networks and the Internet.

Other communities with similar problems or demographics may be able to provide information on program design, public acceptance and participation. See Appendix C.

Power through partnerships

Where possible seek out partners or community groups with a similar agenda. Universities or high schools often have resources and students that can be helpful for research, surveys, implementation or monitoring of projects. Monitoring or research projects are best developed by approaching local educators with a clear outline of the project, the research needed, time constraints and the assistance or training already available. School schedules and term commitments should be accommodated by providing this information in time to prepare well ahead of the start of the term or even the school year. Even primary or junior school children can be valuable partners in some projects.

Designing the Marketing Strategy

A successful design includes these elements:

- Product or desired behaviour change. The desired results and the most practical method of reaching them (the tools) should be defined from the start.
- Pricing plan. Pricing considerations include the willingness or ability of the target group to pay all or some of the costs. Is it essential to recover all or some of the costs? Will the product be made freely available or will the transaction be dignified with a nominal fee? How much effort must the target individuals expend to participate?
- Place or agents for distribution. What are the distribution channels and who is responsible? What time period and facilities (storage and working space) will be needed for distribution?
- Promotion. How, when and where will the program be promoted? What materials such as flyers, brochures and demonstrations will be needed? What is the cost of the promotion? What media contacts, meetings or interviews will take place?
- Partnerships. Who can provide support and resources? Who will set a strong community example or play a leadership role? Are there linkages that can be made with other programs?
- Process for evaluation. It is not always practical to directly assess the impact of a proactive environmental program. It may be possible to monitor the community acceptance of the program and evaluate the success of the methods used. Direct monitoring, if feasible, should be built into the overall strategy and co-ordinated with other initiatives where possible to avoid repetition and wasted effort.

5.3 Promoting Behavioural Change

Communicate effectively

Program participants must understand the problem and the solution must be seen as attainable. Apathy is the natural reaction of individuals faced with overwhelming problems and complex solutions. Target groups must feel that they can make a difference to the problem with some reasonable activity.

The most successful way to reach participants is by personal contact, with trained representatives visiting households after making initial contact by phone or letter. It was observed in the St. Catharines and Toronto case studies that the most effective communication was that undertaken on a house-to-house basis by summer students. It was felt that the students were perceived by the householder as presenting a less "official" manner and possibly engendered some sympathy with their youth or friendly approach.

Printed materials such as flyers, brochures must be attractive and easy to read, and if necessary, in more than one language. An easy to remember tag line, word or symbol is a valuable marketing tool but it is important to ensure that any symbols used really convey the key message to the audience. A useful maxim is "write not only to be understood, but so that you cannot be misunderstood".

Printed materials are usually targeted to a specific audience, i.e., neighbourhoods, schools, industries or interest groups, and should be distributed carefully to gain maximum exposure. The literature must present sufficient information to enable the recipients to make an informed choice about responding to a program or changing behaviour. The City of Toronto found that a detailed information package about their Downspout Disconnection program provided a good response during door-to-door promotions. A recognizable symbol on handout material can be useful in identifying a program, but this should be carefully designed to convey the desired message in a clear unambiguous manner.

Remove barriers

Barriers to successful communication and implementation of a program include language difficulties, social constraints and prohibitive costs. Physical problems such as the structure of older buildings and lots, and the age and infirmity of target residents must be considered. Personal visits, provision of advice, and work with strong neighbourhood associations can identify and assist in removing barriers or misconceptions. Extension of outreach working hours to include evenings and weekends may also contribute to encouraging participation in neighbourhood programs.

Promote commitment

A prior commitment by a participant is much more likely to result in sustained behaviour changes. Commitment strategies include eliciting a verbal or written agreement to participate before a home visit to finalise the participation. Publicly visible commitments, such as identifying "blue box" stickers, window or lawn signs, or lists of willing participants in a community newspaper, are important in producing continued participation and sustained behaviour change.

Reminders or prompts are also useful tools to help promote and reinforce actions such as proper waste disposal, recycling, water saving or composting. The prompts are placed where they will be most likely to remind participants of their commitment. Prompts include the 'Yellow Fish' symbols placed on storm drains as reminders of the connectivity of the drains and the watercourses. There is added value in this program because of the participation of community children, with the implied support of their parents and neighbours. Many householders also do not understand the value of street cleaning apart from æsthetics, and may be less inclined to allow pet waste and garden refuse to accumulate in roadways if the connectivity of storm drains with local waterways was better understood.

Reminders or prompts in the form of refrigerator magnets or other materials can be distributed or used as "prizes" for classroom presentations. These may provide reinforcement at home for desired pollution prevention or water use reduction behaviours, especially if the teacher assigns "follow up" homework activity.

Set good examples

Respected community leaders can have a strong influence on the behaviour of others in the community and the acceptance of the program. Community groups can help neighbours by setting a positive example, by sharing information and assisting with physical changes. Municipal activities should also provide good examples of desired community behaviour such as waste reduction, pollution prevention, water conservation and xeriscaping in local parks. Municipal operations can set an example by using good housekeeping practices, such as proper dust and waste material management during sidewalk repair programs, etc.

5.4 Developing and Implementing Action Plans

What should your plan include?

Your plan should include these features:

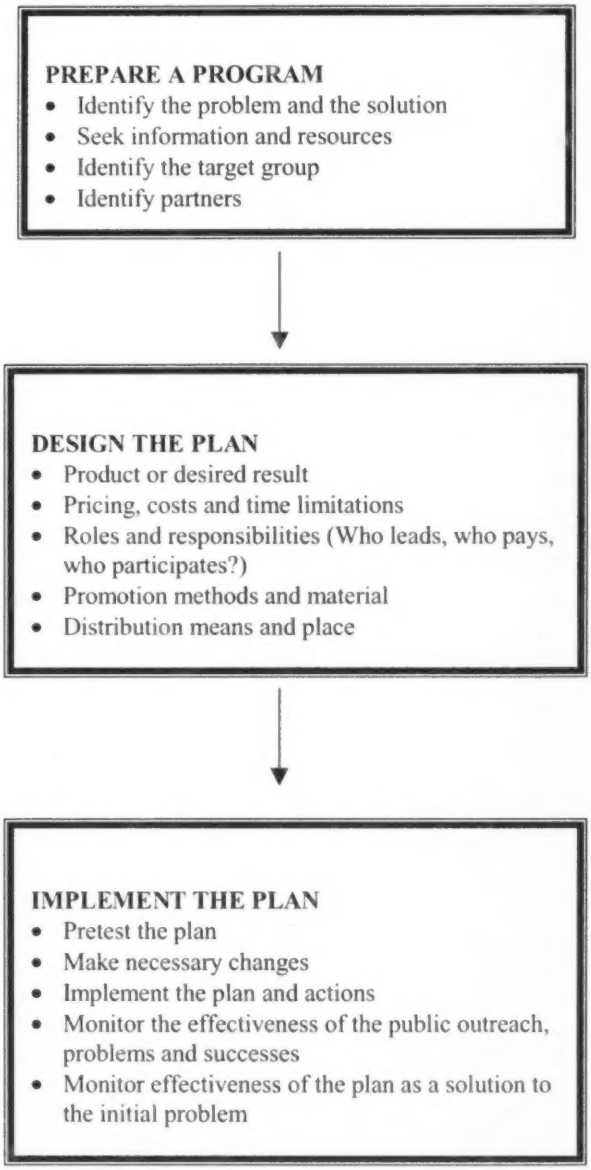
- an objective or goal to be reached;
- a defined target group or geographic area;
- an action or set of actions that will elicit the desired response;
- limiting factors such as costs and timing of other linked programs;
- the time frame within which the actions and responses must take place;
- a marketing, distribution and follow-up protocol;
- a clear understanding of the roles of all participants, staff and partners;
- a reporting and evaluating mechanism.

Figure 5.3 summarizes the three steps to a successful public outreach program, including preparation of a program, and design and implementation of the plan.

Testing and evaluating your plan

Test the action plan first with a focus group or through a pilot project in an area that can be easily monitored. The response can be monitored and the plan refined or changed if necessary before implementing the full community program. Good records should be kept of community responses, problems and recommended future changes. Final evaluation of the results at the completion of the program may not always be possible in proactive environmental initiatives but monitoring should be implemented where possible. Apart from improving future program delivery, the knowledge gained may prove useful for other communities.

Figure 5.3: Steps to a Successful Public Outreach Program


PREPARE A PROGRAM
• Identify the problem and the solution
• Seek information and resources
• Identify the target group
• Identify partners
DESIGN THE PLAN
• Product or desired result
• Pricing, costs and time limitations
• Roles and responsibilities (Who leads, who pays, who participates?)
• Promotion methods and material
• Distribution means and place
IMPLEMENT THE PLAN
• Pretest the plan
• Make necessary changes
• Implement the plan and actions
• Monitor the effectiveness of the public outreach, problems and successes
• Monitor effectiveness of the plan as a solution to the initial problem

Part II – Fact Sheets II

Description of Fact Sheets

Part II of this handbook provides a description of selected pollution prevention and flow reduction measures and fact sheets for each measure. The details on each measure include discussions to assist with the application of the measure including:

- **Description** of the measure and what it includes.
- **Approach** used in the application of the measure. It may include the steps taken and different methods that are available.
- **Benefits** associated with the measure are outlined. This includes any general benefits, the pollutants that are removed or reduced, associated benefits to uses on improved conditions and, where available, information on the performance or effectiveness of the measure.
- **Requirements** for implementation are outlined. These include cost implications, necessary program support, equipment needed (if any), and the policies and/or by-laws generally required for implementation.
- **Public Education/Involvement** opportunities to assist in the application of a measure or development of a program are described.
- **Linkages** of each measure with other programs or related practices are outlined.
- **Limitations** related to each measure that can affect their application and/or performance.
- **Application Experience** is provided in the form of case studies that demonstrate how the measures have been applied and any relevant experiences.
- **References** are listed that are relevant to each measure and provide additional information.

The measures are divided into four categories depending upon the type of application. The four categories and the measures applicable to each are outlined below. Because some measures provide a benefit in more than one area, there are some commonalties between categories.

These Fact Sheets provide a description of the measure discussed, approaches that can be taken, potential benefits, cost and staffing implications, public involvement and application experience.

DESIGN OF FACTSHEETS
LIND DESIGN

Four categories of measures are included and presented below:

Category	Symbol
Pollution Prevention at Source	SP
Flow Reduction at the Lot Level	FR
Municipal Operation Measures	MO
Local Drainage and Inlets	LD

Pollution Prevention at Source (SP)

These measures involve the change in practices or use of chemicals that contribute to pollutants building up on surfaces for wash-off, or that are directly discharged to the storm drainage system. The measures can relate to any type of use including residential, commercial, industrial and municipal practices. The measures outlined include:

SP1 Used Oil Recycling
SP2 Household Hazardous Waste Collection
SP3 Reduced Pesticides Use Through Plant Health Care or Alternative Landscaping
SP4 Safer Alternative Products
SP5 Business Education and Awareness
SP6 Material Storage Control
SP7 Vehicle Use Reduction
SP8 Litter and Pet Control
SP9 Yellow Fish Road Program
SP10 Pool Drainage
SP11 Erosion and Sediment Control
SP12 Modifying Engineering Standards

Flow Reduction at Lot Level (FR)

The measures in this category provide flow reduction to the sewers or conveyance system and provide a corresponding reduction in overall pollutant loadings. Measures address both flows to the sanitary sewer system (water conservation methods) and the storm drainage system (to reduce flows to surface drainage and combined sewers). The measures outlined include:

FR1 Water Conservation Program
FR2 Downspout Disconnection
FR3 Rain Barrel Program
FR4 Storm Garden Development
FR5 Infiltration Measures on Site
FR6 Vegetation Measures – Buffers
FR7 Urban Forests
FR8 Rooftop Treatments

Municipal Operation Measures (MO)

These measures focus on the operations of municipalities in maintaining and rehabilitating infrastructure systems such as the sewer systems, roadways and public lands such as parks. The measures outlined include:

MO1 Sewer Use By-laws
MO2 Road De-icing/Salt Application
MO3 Leaf Cleaning/Removal
MO4 Street Cleaning
MO5 Catchbasin Cleaning
MO6 Storm Drain Flushing
MO7 Municipal Yard Operation
MO8 Municipal & Residential Housekeeping Practices
MO9 Tank Spill Prevention and Control
MO10 Illicit Connection to Storm Sewer – Prevention and Detection
MO11 Leaking Sanitary Sewer Control – Combined and Sanitary (exfiltration)

Local Drainage and Inlets (LD)

Local drainage and inlet measures and practices relate to controls that are applied to urban drainage systems including both surface drainage and local sewer systems. These are generally not "at-source" measures, but relate to the control of how stormwater is conveyed in the upper or early stages of the sewer system, often before entry into the piped storm or combined sewer system. The measures outlined include:

LD1 Grassed Waterways
LD2 Inflow and Infiltration Control (I/I)
LD3 Detention and Infiltration Device Maintenance
LD4 Natural Drainage Elements
LD5 Inlet Controls – Flow Reducers

Pollution Prevention at Source

These measures involve the change in practices or use of chemicals that contribute to pollutants building up on surfaces for wash-off, or that are directly discharged to the storm drainage system. The measures can relate to any type of use including residential, commercial, industrial and municipal practices. The measures outlined include:

SP1 **Used Oil Recycling**
SP2 **Household Hazardous Waste Collection**
SP3 **Reduced Pesticides Use Through Plant Health Care or Alternative Landscaping**
SP4 **Safer Alternative Products**
SP5 **Business Education and Awareness**
SP6 **Material Storage Control**
SP7 **Vehicle Use Reduction**
SP8 **Litter and Pet Control**
SP9 **Yellow Fish Road Program**
SP10 **Pool Drainage**
SP11 **Erosion and Sediment Control**
SP12 **Modifying Engineering Standards**

Used Oil Recycling

SP1

FACTSHEET

DESCRIPTION

Used oil recycling is a responsible alternative to improper disposal practices, such as dumping in the sanitary sewer or storm drain system, applying oil to roads for dust control, placing used oil and filters in the trash for landfill disposal or simply pouring used oil on the ground.

APPROACH

The following approaches may be effective for used oil recycling:

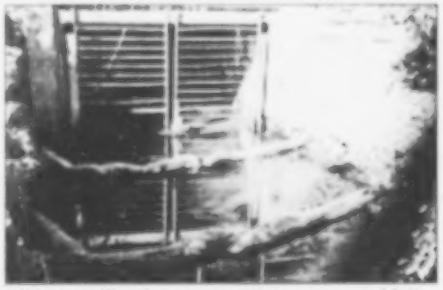
- Integrate efforts with existing municipal solid waste program.
- Set up a municipal collection centre.
- Contract out the collection and hauling of used oil to a private hauler/recycler.
- Utilize the automobile service industry for collection of used oil.
- Work with automotive parts supply stores to reduce incidents of automotive fluids left on paved areas by customers.
- Refer to Disposal Alternatives – Quick Reference Table in Appendix C of this Handbook.

BENEFITS

- **Pollutants Reduced:** Heavy metals, oil and grease.
- **Beneficial Uses Improved:** Aesthetics, contaminated soil and sediments.

REQUIREMENTS

- **Cost Implications:** A collection facility or curbside collection may result in significant costs. Using commercial locations (such as automobile service stations and fast-oil-change businesses) as collection centres reduces hauling and recycling costs for a municipality.
- **Program Support:** If collection and recycling are contracted out, staffing costs are minimal.
- **Policy/By-laws:** Sewer Use By-laws, environmental laws relating to spills, and illegal discharge of contaminants.



Oil booms like these on a storm sewer wouldn't be necessary if used oil recycling programs were in place

PUBLIC EDUCATION/ INVOLVEMENT

- Create procedures for collection such as collection locations and schedule, acceptable containers and maximum amounts accepted.
- Promote public participation through the use of posters, handouts, brochures and announcements in print and broadcast media; provide a list of the commercial recyclers.
- Develop incentive programs for commercial locations and used oil recyclers.

LINKAGES

- **Related practices:** Household hazardous waste collection.

LIMITATIONS

- The availability of reliable, licensed used oil haulers and recyclers may be limited. The program requires frequent public education/ notification messages. The used oil/hazardous waste separation requirements under federal and provincial law may also be a limitation. Meeting zoning, fire, health and safety laws associated with collecting used oil may not be possible at all locations.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

RECYCLE USED OIL

Household Hazardous Waste Collection SP2

FACTSHEET

Type of Measure
FLOW REDUCTION
SOURCE CONTROL
DRAINAGE SYSTEM CONTROL

Program Element
RESIDENTIAL
COMMERCIAL ACTIVITY
INDUSTRIAL ACTIVITY
MUNICIPAL ACTIVITY

DESCRIPTION

Household hazardous wastes (HHWs) are defined as waste materials that typically are found in homes or similar sources and exhibit characteristics such as corrosivity, ignitability, reactivity and/or toxicity, or are listed as hazardous materials. This source control also focuses on the collection of deleterious chemicals that sometimes are disposed of in a manner that threatens stormwater or sanitary sewage quality.

APPROACH

Integrate efforts with existing municipal solid waste program. Optimize collection method(s) (for example, permanent, periodic, mobile (toxic taxi) and curbside) and frequency (for example, monthly and quarterly) based upon waste type, community characteristics, existing programs and budget.

BENEFITS

- **General:** While it is generally recognized that the potential exists for hazardous household materials to come in contact with stormwater runoff or be discharged to sanitary sewers, it is unclear at present how significant this source of contamination is. As such, it is difficult to quantify the benefits to water quality from a household hazardous waste collection program. However, HHW collection is a preventative, rather than curative measure and may reduce the need for more elaborate treatment controls. Pollutants also end up in combined sewer discharges, biosolids from the sewage treatment plant in sewage effluent, and for volatile organics, as an air pollutant.
- **Pollutants Reduced:** Heavy metals, toxic materials, oil and grease. Most common HHWs products include: drain openers, oven cleaners, wood and metal cleaners and polishes, automotive oil and fuel additives, grease and rust solvents, carburetor and fuel injection cleaners, starter fluid, batteries, paint thinners, paint strippers and removers, adhesives, herbicides, pesticides, fungicides and wood preservatives.
- **Beneficial Uses Improved:** Human health, sediment quality, water quality, aquatic life.

Environmental day household hazardous waste collection and proper disposal

Household hazardous products typically found in every home

- **Performance:** Various studies have been undertaken to categorise the quantity and quality of HHWs in the municipal solid waste stream. These studies indicate that 0.5% to 2.0% of the total municipal solid waste stream is household hazardous waste; the number typically used is 1.0% of the total municipal solid waste stream. Although the percentage of these materials is small, the large volume of solid waste generated daily indicates that a substantial amount of HHW is generated.

  The benefits to stormwater quality from HHW collection is unknown at present, but best engineering judgement indicates a potential of up to 15% reduction in specific contaminants. (California Storm Water Best Management Practice Handbooks, 1993, Fact Sheet SC31).

FACTSHEET

Household Hazardous Waste Collection

REQUIREMENTS

- **Cost Implications:** The following cost implications may apply:

  Both collection and disposal can be expensive and are partly a function of frequency of collection, which depends on the collection program implemented. Many communities have deferred hazardous household waste (HHW) programs because of the high cost. Cost depends on the type of program chosen and available disposal costs.

  Trained operators are required.

  Laboratory and detection equipment is necessary.

  Extensive record keeping is required including dates, types and quantities.

- **Program Support:** This best management practice (BMP) may require a minimum of six highly trained persons per collection site or event to handle traffic, waste drop-off, characterization and disposal.
- **Policy/By-laws:** Sewer use by-laws limit discharge to storm and sanitary sewers.

PUBLIC EDUCATION/ INVOLVEMENT

- The following considerations may be applicable for this BMP:

  Public education about hazardous materials in the home and consequences of improper use or disposal.

  Identification and promotion of the use of non-hazardous alternatives.

  Identification of proper storage and disposal methods.

  Promotion of participation in local HHW collection programs.

  Distribution of posters, handouts and educational efforts aimed at local schools.

  Using public service announcements on local television, radio and newspapers.

  Adding utility bill inserts.

  Making video or slide presentations to community organizations.

  Developing a "speaker bureau" of local environmental professionals and recycling experts.

LINKAGES

- **Program:** Solid waste program, sewer use by-law enforcement, and used oil recycling.
- **Related practices:** Safer alternative practices.

LIMITATIONS

- This BMP may be limited to areas with convenient access to hazardous waste disposal facilities and recycling facilities because of the cost associated with transport. This BMP can be a high-cost option compared to the other source controls. There are significant liability issues involved with the collection, handling and disposal of household hazardous waste.

APPLICATION EXPERIENCE

The Household Hazardous Waste Program for the Regional Municipality of Waterloo is based at the Regional Land Fill Site and has designated public dates for receiving waste. Dates are publicized in public information flyers distributed throughout the region.

REFERENCES

- David V. Galvin, *Household Hazardous Waste in Municipal Wastewater and Storm Drains: An important Target for Comprehensive Pollution Prevention Programs*; WPCF Conference Proceedings Toronto, AC91-068-004, 1991.
- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Reduced Pesticide Use

SP3

Through a Plant Health Care Program or Alternative Landscaping

FACTSHEET

Type of Measure
FLOW REDUCTION
SOURCE CONTROL
DRAINAGE SYSTEM CONTROL
Program Element
RESIDENTIAL
COMMERCIAL ACTIVITY
INDUSTRIAL ACTIVITY
MUNICIPAL ACTIVITY

DESCRIPTION

Rather than work against nature, Plant Health Care Programs (PHCP) can be designed to work with it. By consistently employing organic horticultural practices, healthy turf growth can be encouraged while having the smallest possible environmental impact. Pesticides in this context include insecticides, fungicides and herbicides.

Naturescaping promotes natural lawn care techniques and encourages lawn replacement with alternatives, including drought-tolerant plants. Xeriscape landscaping is an alternative landscape method that emphasizes water conservation.

APPROACH

- A PHCP has ten component parts:
  1) Monitoring/Scheduling
  2) Mowing
  3) Fertilizing
  4) Aerating
  5) Top-dressing
  6) Overseeding
  7) Irrigating
  8) Dethatching
  9) Alternatives
  10) Education/Training
- Natural lawn care techniques are available that offer natural solutions to some of the most common lawn problems.
- Xeriscaping can be defined as "quality landscaping that conserves water and protects the environment". Seven principles are applied: 1) Planning and design, 2) Soil analysis, 3) Appropriate plant selection, 4) Practical turf areas, 5) Efficient irrigation, 6) Use of mulch, and 7) Appropriate maintenance.
- An integrated Pest Management Program can include biological controls using "beneficial" insects as alternatives to pesticides (e.g. ladybird beetles, praying mantis).

BENEFITS

- **General:** Healthy vigorous turf is less susceptible to pest invasion; water use is reduced; there is less runoff; and maintenance costs are often reduced.
- **Pollutants Reduced:** Nutrients, Oxygen Demanding Substances, pesticides, herbicides and fungicides.
- **Beneficial Uses Improved:** Contaminated sediments, aesthetics, water quality.
- **Performance:** Consistent implementation of proper cultural practices will reduce the need for pesticide use and reduce negative environmental impacts.

Pesticide-free lawn care

REQUIREMENTS

- **Cost Implications:** Costs may be reduced for lawn care chemical applications and water use. There may be more initial labour involved than in pre-program practices.
- **Program Support:** Primarily related to education in using alternate techniques.
- **Equipment:** Specialized lawn care equipment may be needed for dethatching and aeration.
- **Policy/By-laws:** A PHCP need not advocate a complete ban on pesticide use, but can recognize that there may be occasions when spraying is necessary.

FACTSHEET

Reduced Pesticide Use Through a Plant Health Care Program or Alternative Landscaping

PUBLIC EDUCATION/ INVOLVEMENT

Promotion through media, local newspapers, and television stressing the positive aspects of reducing pesticide use.

- Interpretive signage in demonstration areas.
- Staff contact available to deal with queries and concerns.
- Positive reinforcement community activities such as the Dandelion Festival, in Waterloo.

LINKAGES

- **Program:** Flow reduction, water conservation.
- **Related practices:** Integrated pest management.

LIMITATIONS

- Some neighbourhood groups or individuals may be strongly opposed to the program because of their aesthetic preferences for traditional lawns.

APPLICATION EXPERIENCE

- "Innovative Turf Management" is a Plant Health Care Program (PHCP) implemented by the City of Waterloo gradually over many years. The program has successfully reduced pesticide application from 73% of the City's total land area in 1979 to 0.5% in 2001. For further information contact Mr. Brian Detzler, Team Leader Parks at (519) 747-8611.
- The Don Watershed Program distributed "No Pesticide" lawn signs with the popular Don Frog logo.

REFERENCES

- *Alternatives to Pesticides* is a publication available courtesy of the City of Cambridge, City Green Cambridge and Health Canada.
- *Naturescaping* is a brochure offering alternatives to the traditional lawn including a list of plants suitable for southern Ontario and is available from the Region of Waterloo by calling (519) 575-4423.
- *Xeriscape Landscaping – Preventing Pollution and Using Resources Efficiently*, EPA-840-B-93-001, April 1993.
- *How to Get Your Garden off Drugs. Friends of* the Earth, 701-251 Laurier Avenue West, Ottawa, Ontario, K1P 5J6. (613) 230-3352.

Safer Alternative Products

SP4

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Promote the use of less harmful products. Alternatives exist for most product classes, including fertilizers, pesticides, cleaning solutions and most automotive and paint products.

APPROACH

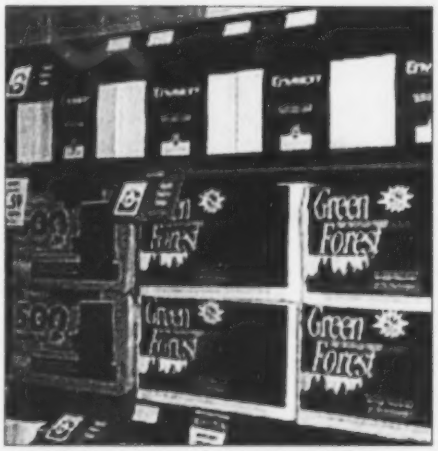
- Pattern a program after the many established programs from municipalities across the country. Integrate this best management practice (BMP) as much as possible with existing programs within your municipality.
- This BMP has three key audiences: municipal employees, the general public, and small business.

BENEFITS

- **General**: Promoting the use of less harmful products can reduce the amount of toxic and deleterious substances that enter storm and sanitary sewers and ultimately reach receiving waters.
- **Pollutants Reduced:** Nutrients, Toxic Materials, Oxygen Demanding Substances, and Oil and Grease.
- **Beneficial Uses Improved:** Human health, water and sediment quality, aquatic life.
- **Performance:** Quantified pollutant reduction.

REQUIREMENTS

- **Cost Implications:** The primary cost of this BMP is for staff time. Use of some alternative products may result in cost savings.
- **Program Support:** Staff is needed to educate municipal employees and coordinate public education efforts. Municipal employees who handle potentially harmful materials should be trained in the use of safer alternatives. Purchasing departments should be encouraged to procure less hazardous materials.
- **Equipment:** There are no major equipment requirements to this BMP.
- **Policy/By-laws:** This BMP has no additional regulatory requirements. Existing regulations already require municipalities to reduce the use of hazardous materials. Safer alternatives for use by the general public are presented through education.



Special alternative product tags on retail store shelves

PUBLIC EDUCATION/ INVOLVEMENT

- Awareness is the key to successful implementation of this BMP. It promotes a willingness to try alternatives and modify old behaviours.
- The following are examples of topics to be covered under a public education program:
- Automotive products – Less toxic alternatives are not available for many automotive products, especially engine fluids. But there are alternatives to car polishes, degreasers and windshield washer solution. Re-refined, recycled oil is also available.
- Cleaners – Vegetable based or citrus-based soaps are available to replace petroleum-based soaps/detergents.
- Paint products – Water based paints, wood preservatives, stains and finishes are available.
- Pesticides – Specific alternative products or methods exist to control most insects, fungi and weeds.
- Fertilizers – Compost and soil amendments are natural alternatives.

LINKAGES

- **Program:** Pesticide Use Reduction, Household Hazardous Waste Reduction.
- **Related practices:** Naturescaping.

FACTSHEET

Safer Alternative Products

LIMITATIONS

- Safer alternative products may not be available, suitable or effective in every case.

APPLICATION EXPERIENCE

City of Waterloo promotion of alternatives to pesticides through literature for homeowners and a commitment to an Environment First policy for city operations.

REFERENCES

- *Hamilton-Wentworth Enviro-Guide for Students and Residents* (1996). Hamilton-Wentworth Regional Environment Department, Waste Management Division. (905) 546-4417.
- *Home Green Home – Your Guide to Homemade Alternative for Household Use*. Communication Services, Region of Peel, 10 Peel Centre Dr., Brampton, ON L6T 4B9.
- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.
- Toronto and Region Conservation Authority web site: www.trca.on.ca

RECIPES FOR THE ENVIRONMENT

(Reference: Toronto and Region Conservation Authority)

Helping to protect the environment starts in your own home. You can make environmentally friendly cleaners from products in your kitchen cupboards and refrigerator. These products are easy to make, and they don't contain any harmful chemicals.

MAKE THE RIGHT CHOICE

Instead of:	Try this!
Flea collars	Add garlic tablets, vitamin B or brewer's yeast to your pet's diet. (Consult your veterinarian.)
Ant poison	Place red chilli powder, paprika, dried peppermint leaves at entry points to deter entry of ants.
Fertilizers	Use unfinished compost, mulch.
Insecticides	**Inside** – spray plants with mixture of 1/2 capful of dish detergent and 500ml of water, rinse when insects are dead, repeat every 2 weeks. **Outside** – introduce predators like ladybugs and preying mantis, companion planting.
Slug/snail poison	Saucer of beer or brewer's yeast in garden.
Air fresheners	Boil cinnamon and cloves in water, place out an open box of baking soda.
Swimming pool chemicals	Ozone or ultra-violet light systems.
Abrasive cleaners	Rub area with lemon dipped in borax, rinse and dry.
Ammonia-based cleaners	Mix vinegar, salt and water for surface areas. Baking soda and water for bathroom tiles.
Drain declogger	1-2 handfuls of baking soda, half cup of vinegar, allow to set for 1 hour, run water.
Floor & furniture polish	Mix 1:2 parts lemon juice to olive oil or vegetable oil.
Silver polish	Soak in boiling water with baking soda, salt and a piece of aluminum foil.
Window cleaner	Mix 2 tablespoons of vinegar in 1 litre of water in an empty spray bottle.

Business Education and Awareness SP5

FACTSHEET

DESCRIPTION

Promotion of education to the business and industrial community on the impact of pollution on the environment and the pathways of pollution in an industrialized watershed. Fostering an environment where expertise and information can be shared on pollution prevention at source.

APPROACH

Components of a business education program can include:

- Surveying area businesses to determine what potential presently exists for at-source pollution control.
- Identification of key business individuals that may become involved in an "umbrella" association to review the needs of the business community, education on pollution prevention and applicable Best Management Practices (BMPs). The focus of the group can include information sharing, networking and contacts that will assist small business by providing low cost expertise.
- Provision of seminars, fact sheets and information packages on BMPs related to area businesses, and also on ISO 14001 Environmental Management Systems.
- Evaluation of the need and/or opportunities in a municipality to provide financial incentives to businesses to implement BMPs.
- A newsletter to provide BMP updates, technical advice and contact information.
- Media coverage of success, business co-operation and participation.

BENEFITS

- **General**: Measures adopted for pollution prevention can also improve safety and reduce energy costs.
- **Pollutants Reduced:** Sediment, Nutrients, Toxic Materials, Oxygen Demanding Substances, Oil and Grease.
- **Beneficial Uses Improved:** Human health, water and sediment quality, and aquatic life.
- **Performance:** Measured in terms of program performance, i.e. the degree to which a targeted sector or group of industries adopts programs such as pollution prevention or Environmental Management Systems (EMS).

ISO 14001 standards for environmental management systems

REQUIREMENTS

- **Cost Implications:** A municipal staff person is needed to assist in co-ordination of surveys of area businesses, formation and support of any committees, and provision of educational materials, seminars, etc. Costs will vary according to educational materials provided and method of distribution, seminar expenses and other outreach projects.

  All costs involved in implementing new practices are borne by the company concerned. Changes to industrial and business practices may also reduce costs for some operations as well as providing environmental benefits.
- **Program Support:** Staff time will be needed for business outreach programs and preparation of materials.
- **Equipment:** Equipment needed will depend on the BMPs implemented and costs will be borne by the business concerned.
- **Policy/By-laws:** The need to develop education programs and awareness of pollution issues is driven by due diligence concerns or as part of a in-house program to develop a pollution prevention program, spill control plan, environmental management system or a best management practices plan.

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

FACTSHEET

Business Education and Awareness

PUBLIC EDUCATION/ INVOLVEMENT

- This program is in essence a public education program geared to a specific segment of the population. An "advisory committee" of members of the public business sector will be invaluable in promoting Best Management Practices (BMPs) throughout local industries and providing technical advice and influence. Some form of mentorship will be a valuable tool to provide advice and experience to small businesses. Public recognition should be given to participating businesses through media events, newspaper articles, awards, etc.

LINKAGES

- **Program:** Hazardous Waste Reduction, Spills Control, Material Storage Control, Use of Alternative Products.
- **Related practices.** Water conservation, workplace health and safety.

LIMITATIONS

- There may be some perception in the business community that remedial action may be too costly to implement. Lack of understanding about watershed connections and individual responsibility for pollution prevention may prove difficult to overcome.

APPLICATION EXPERIENCE

Emery Creek is a tributary of the Humber River draining a mixed industrial-commercial-residential area in Toronto. The Emery Creek Environmental Association is an industrial association that was formed in 1993 to address watershed concerns.

Regional Municipality of Waterloo. A Water Resource Protection Liaison Committee was formed in 1994, and includes regional staff and business, environmental and agricultural interests. Working groups focus on promoting voluntary resource protection in urban business and industries with a special focus on groundwater protection areas. BMP Fact Sheets have been developed for some industries in the areas of concern.

REFERENCES

Toronto and Region Conservation Authority and Environment Canada, 1998, *Your Business, the Don, Your Watershed, Making the Connection*, a special publication brochure directed at company presidents or general managers.

MOE, 1993, *Pollution Prevention Planning Guidance Document and Workbook*. Queen's Printer, ISBN 0-7778-1441-2

Canadian Centre for Pollution Prevention, 1998, ISO 14000 Guidance Document for a Business Community, prepared for the Ministry of the Environment and Emery Creek Industrial Association.

Material Storage Control

SP6

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Material storage controls can prevent or reduce the discharge of pollutants to stormwater from material delivery and storage areas. This can be done by reducing the storage of hazardous materials on site, storing materials in designated areas, installing secondary containment, conducting regular inspections and training employees and subcontractors.

This Best Management Practice (BMP) primarily applies to material delivery and storage for municipal and commercial operations.

APPROACH

The key is to design and maintain material storage areas that reduce exposure to stormwater by:

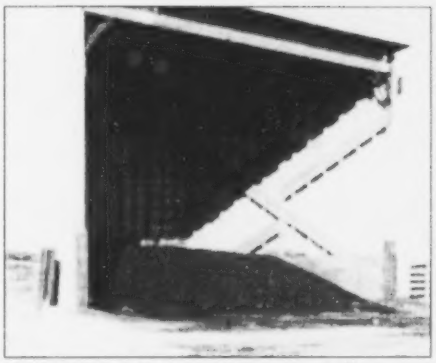
- Storing materials inside or under cover on paved surfaces;
- Using secondary containment, where needed;
- Minimizing storage and handling of hazardous materials and inspecting storage areas regularly;
- Keeping an ample supply of absorbent spill clean-up materials near the storage area.

BENEFITS

- **General**: With preventative BMPs, benefits include reduced liability, due diligence, and improved public image for commercial operations.
- **Pollutants Reduced:** Sediment, Nutrients, Toxic Materials, Oil and Grease.
- **Beneficial Uses Improved:** Aesthetics, sediment and water quality, aquatic life
- **Performance:** This is a preventative technique.

REQUIREMENTS

- **Cost Implications:** Costs will vary depending on the size of the facility and the necessary controls.
- **Program Support:** Accurate and up-to-date inventories should be kept of all stored materials. Employees should be well trained in proper material storage. Employee education is paramount for successful BMP implementation.



Inside materials storage reduces washoff

- **Equipment:** Spill response equipment and supplies.
- **Policy/By-laws:** Sewer use by-law, environmental laws relating to spills.

PUBLIC EDUCATION/ INVOLVEMENT

- Promote awareness of appropriate "at home" material storage.

LINKAGES

- **Program:** Pollution Prevention and Control; Environmental Management System; Spill Control; Building Codes; and Fire Codes.
- **Related practices:** Business Education and Awareness.

LIMITATIONS

- Storage sheds often must meet building and fire code requirements.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993

Vehicle Use Reduction

SP7

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Reduce the discharge of stormwater pollutants from vehicle emissions by highlighting the stormwater impacts; promoting the benefits to stormwater of alternative transportation; and integrating initiatives with existing regulations and programs.

APPROACH

- **Integrate efforts with:**
  - government agencies, business and municipal programs to reduce vehicle use to improve air quality and public health;
  - transit system redesign, expansion, and public transit use promotions;
  - residential street redesign such as the addition of bicycle lanes and traffic calming initiatives;
  - subdivision planning through community trail design, neighbourhood focused services;
  - local bicycle and road safety programs.
- Establish ride-share and trip reduction programs at government offices, major employers and universities.
- Promote car-pooling between urban centres by the provision of no-cost commuter parking, commuter lanes and toll reduction incentives.

BENEFITS

- **General**: Reduced pollutants entering storm drains and local waterways from roadways. Public health benefits through improved air quality and personal exercise. Reduced energy consumption and reduced cost to participants. Less highway congestion with reduced potential for accidents.

  Marsalek (1999) reported on the toxicity of urban drainage, including highway runoff. Severe toxicity occurs due to metals, hydrocarbons, sodium and calcium chloride. Many of these materials are traffic related so a reduction of traffic can reduce toxicity.
- **Pollutants Reduced:** Toxic materials (including antifreeze), rubber, carbon compounds, oil and grease.

Multiple occupancy vehicle use encouraged

- **Beneficial Uses Improved:** Public health, swimming, fishing, aesthetics, and contaminated sediments.
- **Performance:** Studies show that reducing vehicle deposits on roadways is likely to have a significant impact on local water quality, with potential improvement in aquatic habitat. There should be a reduction in the amount of pollutants entering major lakes and rivers, and some reduced costs of pollutant removal at water intake plants. Highway expansion needs and road maintenance costs may also be reduced.

REQUIREMENTS

- **Cost Implications:** A staff person is needed to track, review and comment on emerging legislation and programs, and provide coordination of proactive efforts. Other costs will be determined by the level of integration with related programs and services, and the type of remediation undertaken. Projects can vary from the simple installation of donated bicycle racks to the construction and maintenance of major commuter parking facilities.

FACTSHEET

Vehicle Use Reduction

- **Program Support:** The cost of proactive preventative programs will vary and may be shared with other programs and agencies. This again will be determined by the level of integration with other programs and the remediation measures undertaken.
- **Equipment:** Requirements will vary according to the program required.
- **Policy/By-laws:** Anti-idling By-law can reduce some vehicle use impacts.

PUBLIC EDUCATION/ INVOLVEMENT

The following considerations may be applicable:

- Educate the public about the problem of pollutants from vehicles transported via stormwater from the roads to local waterways.
- Promote and co-ordinate the use of alternative transport arrangements such as ride sharing, "bike to work" days, and workplace car-pool networks.
- Promote the advantages of local or inter-city public transport.
- Promote healthy activities such as walking and cycling. Use bicycle rodeos, community rides and peer influence to promote the enjoyment of cycling.
- Promote good cycling practices and road safety through school and youth programs and driver education.
- Use public workshops or public meetings to identify opportunities for improving community trails and municipal transit.
- Distribute promotional materials through libraries, recreation centres and public facilities.
- Use radio and television promotions and community group sponsorship for special campaigns or programs.
- Promote proper maintenance of vehicles in use.

LINKAGES

- **Program:** Pollution Prevention and Control; Energy and Traffic Reduction Programs; 20% Club for Sustainable Cities; International Council for Local Environmental Initiatives (ICLEI) and Cities for Climate Protection. Development of community walking trails, and bicycle lanes.
- **Related practices:** Public health promotion (ParticipAction).

LIMITATIONS

- Economic restraints and lack of cooperation may limit the level of integration between departments and programs.
- The use of alternative transportation is highly dependent on its convenience and relative cost.
- Erratic work hours may limit opportunities for "car-pooling" and ride sharing.
- Lack of workplace shower and locker facilities deter some employees from cycling or walking to work.
- Climate conditions limit walking and cycling opportunities.
- City traffic conditions inhibit cyclists from undertaking neighbourhood trips.

APPLICATION EXPERIENCE

- Toronto Cities for Climate Protection emissions reduction program. Contact ICLEI, World Secretariat, City Hall 16th Floor, West Tower, Toronto. Phone (416) 392-1475. The Toronto Case Study is posted at the website: www.iclei.org

REFERENCES

- Marsalek, J., Q. Rochfort, B. Brownlee, T. Mayer and M. Servos (1999). *An exploratory study of urban runoff toxicity*. Wat. Sci.Tech. Vol. 39. No. 21, pp. 33-39.
- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Litter and Pet Control

SP8

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Litter, usually consisting of packaging material, is discarded by individuals over the urban landscape. Pet feces (often called pet litter) are deposited primarily by dogs and left uncollected by owners. Both types of litter end up in storm drainage and cause problems.

Control programs involve changing individual behavior by preventing the littering action. By-laws making the littering illegal, supported by fines, are the "backbone" of the prevention programs.

Vegetation from lawn and gardens is another source of litter that should be reduced.

APPROACH

- Municipal ordinances (by-laws) exist in most municipalities making littering an offence.
- Several municipalities have dog litter control by-laws. Part of the old City of Toronto has a "Stoop and Scoop" by-law, with a $105 fine for not picking up after your pet.
- Public education to prevent the littering activities by individuals and their pets has the most promise.
- Municipal programs to post signs informing the public of the result of illegal littering helps prevent the activity.
- Municipalities and commercial businesses can provide litter disposal containers to make it convenient for the user.
- Education, garden/yard waste pick-up programs and composting programs can all reduce lawn and garden litter from entering drainage systems.

BENEFITS

- **General**: Aesthetic improvement in the urban landscape is the most obvious benefit. Pollution prevention in watercourses is also important.
- **Pollutants Reduced:** Floatable materials, oxygen demanding substances, nutrients, and bacteria.
- **Beneficial Uses Improved:** Swimming, and aesthetics.

Pet litter bylaws to control animal wastes

High bacteria levels lead to beach closures

REQUIREMENTS

- **Cost Implications and Program Support:** The municipality is the driving force in this measure with support for programs to pick up and dispose of lawn and garden wastes, maintenance of catchbasins and street sweeping programs, litter control through signage, provision and emptying of litter containers, and by-law enforcement.
- **Policy/By-laws:** Stoop and Scoop and Anti-Litter by-laws should be enacted and enforced.

FACTSHEET

Litter and Pet Control

PUBLIC EDUCATION/ INVOLVEMENT

- Summer student programs can incorporate park survey and public education by interviewing dog owners about litter control benefits and by-laws.
- By-law signage should be extensive.
- Bag dispensers can be located in parks.
- Trash cans should be readily available and emptied frequently.

LINKAGES

- **Related practices:** Street sweeping, catchbasin cleaning.

LIMITATIONS

- The program success is dependent on public education and enforcement of the By-law. Although many municipalities have Stoop and Scoop by-laws, enforcement may be limited because of staff shortages. Fines vary significantly throughout Ontario with ranges from over $200 to small fines of a few dollars.

APPLICATION EXPERIENCE

- In the City of St. Catharines' experience, bags for the Stoop and Scoop program cost $160 per 1500 for a sophisticated type of bag. Costs are lower for simple plastic bag printed with a reference to the by-law. See the City of St. Catharines Case Study for more information on this program, see Part III.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Yellow Fish Road Program

SP9

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Stencilling of storm drain system (inlets, catchbasins, channels and creeks) with warnings/advisories and graphic icons, such as yellow fish, discourages the illegal dumping of unwanted materials. Advisories are distributed to homes in stencilled areas.

APPROACH

Create a volunteer workforce, preferably school children, to reflect the initial principle of the program to stencil storm drain inlets. Municipal staff should erect signs near drainage channels and creeks and in heavy traffic areas.

BENEFITS

- **General**: An effectively implemented stencilling program encourages change in personal behavior and helps minimize non-point source pollutants from entering the storm drain system. Catchbasin maintenance is simplified through the reduction of disposed materials into storm drain inlets.
- **Pollutants Reduced:** Sediment, Nutrients, Toxic Materials, Floatable Materials, Oxygen Demanding Substances, Oil and Grease.
- **Beneficial Uses Improved:** Aesthetics, sediment and water quality.
- **Performance:** Program performance is indirect and measured by the level of participation of both the students carrying out the program and the education and involvement of the residents in the area where the measure is applied. Many youth volunteers have participated in this activity with the Toronto and Region Conservation Authority (over 3500 in 1999). Yellow Fish Road is endorsed and supported by many organizations including Trout Unlimited Canada, The Toronto and Region Conservation Authority, The City of Toronto, Regions of York, Peel and Durham, Girl Guides of Canada, Scouts Canada, and many Boards of Education.

REQUIREMENTS

- **Cost Implications:** A volunteer workforce serves to lower the program costs.

  Stencilling kits require procurement of durable and disposable items.

Children participating in the yellow fish road program

  The storage and maintenance of stencilling kits requires planning.

  The program should aid in the cataloguing of the storm drain system.

- **Program Support:** The primary staff demand is for program setup to provide marketing and training. A minimum of two persons is required for stencilling in high-traffic areas and commercial and industrial zones with appropriate safety measures in use (for example, reflective vests, flag person and signage).
- **Equipment:** Storm drain stencilling kits which include stencil, paint, paint brush, plastic gloves, catchbasin map, clipboard, instructions, liability release form, identification form, rags, whisk broom or brush, paper towels, trash bags, safety vest and a 5 gallon bucket to hold materials. Storm drain marking kits are now available that use plastic plaques or markers and adhesive rather than stencils.
- **Policy/By-laws:** Develop, implement and enforce an ordinance that requires inlets, catchbasins, channels and creeks to be fitted with anti-dumping, pollution prevention signs. Sewer use by-laws prohibit certain discharges to storm sewers.

PUBLIC EDUCATION/ INVOLVEMENT

- Promote participation through schools and scouting and guiding groups. Promote volunteer services (individual and business) through radio, television and mail-out campaigns. Encourage public reporting of improper waste disposal by a publicized hotline number (or stencilled onto the storm drain inlet). Training sessions of

FACTSHEET

Yellow Fish Road Program

approximately 10 to 15 minutes will cover stencilling procedures, including how to stencil, record keeping and problem drain notation. Also consider proper health and safety protocols (such as the buddy system, traffic and health concerns).

LINKAGES

- **Program:** Flow reduction; pollution prevention and control; Environmental Management System.
- **Related practices:** Used oil recycling, household hazardous waste disposal.

LIMITATIONS

The following limitations may apply:

- Private property access limits stencilling to publically owned areas.
- This program is dependent on volunteer response.
- Storm drain inlets that are physically blocked will be missed or require follow-up.
- High-traffic, commercial, industrial zones will be the responsibility of city staff.

APPLICATION EXPERIENCE

- Grand River Conservation Authority. See the website at www.grandriver.on.ca.
- Toronto Region Conservation Authority. See the website at www.trca.on.ca.

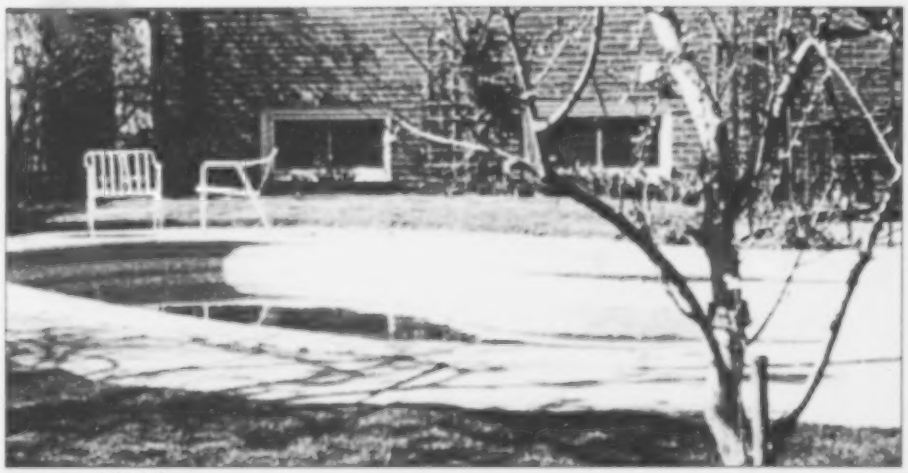
REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Pool Drainage

SP10

FACTSHEET



Winter pool drawdown

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Pools and spa water containing chlorine can be toxic to aquatic life. Pool backwash water containing sediment can cause sediment pollution of surface waters. The drawdown of pools prior to winter may release a large volume of water to the surface water or to combined sewers.

Outdoor swimming pools require regular maintenance, involving chemical treatment, backwashing (rinsing the filter with clean water), and winterizing. Chemical additives include chlorine or bromine to maintain pool quality, and products such as pH-up or muratic acid, which are occasionally used to maintain acid balance. Weekly backwashing is necessary to remove particles from the pool filter. Backwashing can draw down the pool water level by about one inch, and the backwashed water, containing sediments collected on the filter, is usually discharged to the lawn or driveway. In the fall, owners must blow out the pool lines (i.e. circulation, pump and filter) to avoid freezing and cracking over the winter. This winterizing activity usually results in the drawdown of in-ground pool water level by about one quarter of the pool volume, while above ground pools and spas are completely emptied.

Advice should be given to landowners by municipalities, conservation authorities and resident associations on environmentally acceptable ways to discharge pool backwash water and drawdown water for winterizing.

APPROACH

In order to have the least environmental impact, pools should be emptied at least three days after the last intense chemical application. The chlorine residual should be virtually absent.

- Backwash water is contaminated by filtered sediments and pool operators should discharge this water either to the sanitary sewer, or across the lawn to the storm sewer. By allowing pool water to flow across a lawn, some water will be lost through infiltration, some sediments will be filtered, and most remaining pool chemicals will volatilize to the air.
- If backwash water is discharged to the sanitary sewer, residents should take care to not also discharge winter drawdown water to the sanitary sewer because of the potential impacts of increased flow volume.
- In combined sewer areas, where no storm sewer exists, residents should be aware of the impacts of additional flow on the conveyance and treatment system. In these areas, infiltration measures should be encouraged to reduce the volume of water draining to the sewer system.
- Residents should be advised not to discharge the pool water onto neighbouring properties.
- Residents should be discouraged from discharging pool water into ravines to avoid erosion and slope failure.

FACTSHEET

Pool Drainage

BENEFITS

- **General**: Potentially toxic discharges will be avoided, groundwater infiltration will be enhanced, and nuisance avoided. In combined sewer areas, flow reduction will result in reduced operational costs for conveyance and treatment.
- **Pollutants Reduced:** Sediments, toxic chlorine discharges.
- **Beneficial Uses Improved:** Aesthetics, water quality, and aquatic life.

REQUIREMENTS

- **Cost Implications:** Minimal. An information flyer could be developed for distribution with water bills (since pool owners use a substantial amount of water).
- **Program Support:** Municipal staff should be aware of the recommended pool discharge method in order to respond to queries from residents.
- **Equipment:** None.
- **Policy/By-laws:** The sewer use by-law could contain a prohibition for draining pools into sanitary sewers. A discharge policy should be developed.

PUBLIC EDUCATION/ INVOLVEMENT

- Resident groups should be advised of the discharge policy. Residents with pools are the primary targets of the policy.

LINKAGES

Program: Flow reduction, source control.

- **Related practices:** Infiltration measures, natural drainage system.

REFERENCES

- *Residential and Commercial Source Control Programs to Meet Water Quality Goals*, Water Environment Research Foundation, Project 95-IRM-1, 1998, page 4-18.
- *Swimming Pool Discharge Water*, staff report, Toronto Region Conservation Authority, Nov. 11, 1996.

Erosion and Sediment Control

SP11

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

Erosion silt fencing at a construction site

DESCRIPTION

This measure is primarily developed for construction sites where erosion and sedimentation rates are usually very high. It aims at preventing erosion on the site, and preventing sediment from leaving the site boundary.

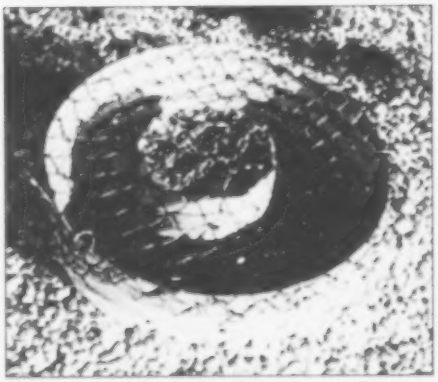
APPROACH

Erosion and sediment control should be practiced on every construction site before and during construction. Planning of effective erosion and sediment control should follow these basic principles.

- Install sediment and erosion controls before removal of vegetative cover.
- Minimize the extent of the disturbed area and the duration of exposure.
- Stabilize and protect disturbed areas as soon as possible.
- Keep runoff velocities low.
- Protect disturbed areas from runoff.
- Retain sediment within the corridor or site area.
- Implement a thorough maintenance and follow-up program.

Erosion and sediment control practices can be classified as:

1. Temporary Cover Practices (e.g. seeding, mulching).



Stormwater outlet designed to reduce sediment discharge

2. Permanent Cover Practices (e.g. sodding, vegetative buffer strips).
3. Erosion Control Using Vegetative Practices (e.g. silt fencing, straw bales, sediment basins, sediment traps, sewer inlet traps).
4. Sediment Control Practices (e.g. temporary runoff controls, rock check dam, interception berm/swale).

An erosion and sediment control plan should be prepared by a professional engineer or technician. A municipal inspector should check the practices after installation as well as after major storm events.

FACTSHEET

Erosion and Sediment Control

BENEFITS

- **General:** Nearby drains and watercourses will be protected from sediment loads during rainstorms, preventing negative impacts on water quality. Soil loss from the site will be reduced. There may be some reduction in flow volumes.
- **Pollutants Reduced:** Sediment, Nutrients, Floatable Materials, and Oxygen Demanding Substances.
- **Beneficial Uses Improved:** Aesthetics, water quality, and aquatic life.

REQUIREMENTS

Cost Implications

Construction and maintenance costs of erosion and sediment control practices should be incorporated into the project cost. Municipal staff costs are incurred with the provision of site inspections and reviewing planning permits if necessary.

Program Support

- **Staff:** Conservation authorities and municipal reviewers assist developers by providing guidance on design of sediment and erosion control works.
- **Equipment:** There is no particular equipment requirement, except for landscaping materials and equipment while constructing some types of silt barriers.
- **Policy/By-laws:** Sediment and erosion control are usually required as conditions on subdivision or site plan development. Some municipalities require sediment and erosion control by adopting a Topsoil Removal By-law under Ontario's Topsoil Preservation Act.

PUBLIC EDUCATION/ INVOLVEMENT

- Construction site workers may need some education on the value of sediment control measures and their relationship to a healthy watershed. At some larger, possibly municipal, construction sites there may be some public education value in an interpretive message board explaining the methods used to prevent water pollution.

LINKAGES

- **Program:** Pollution prevention and control, Environmental Management System.
- **Related Practices:** Detention and Infiltration Device Maintenance, and Street Cleaning.
- **Application Experience:**

  The Town of Aurora, Ontario has adopted a Topsoil Removal By-law which requires plans to be submitted for erosion, sedimentation control and rehabilitation including monitoring and maintenance, and sedimentation basins and other measures to be in place prior to any development.

  Mississauga has a by-law regulating earth works on urban construction sites. To obtain a permit the developer must submit an erosion and sediment control plan and provide financial securities to the City to ensure that the required works are properly installed and maintained. A fee is charged to offset the City's costs for plan review and site inspection.

REFERENCES

Ontario Ministry of the Environment, Ministry of Natural Resources, et. al., 1987, *Guidelines on Erosion and Sediment Control for Urban Construction Sites*

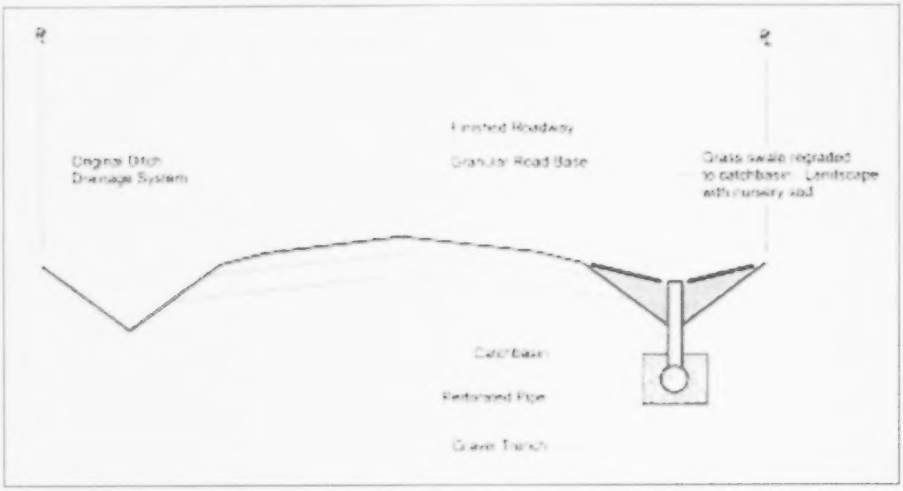
Credit Valley Conservation Authority, 1990, *Sediment Control Guidelines for Development*

Janice Teare, Michael Won, 1993, *Erosion and Sediment Control on Urban Construction Sites*. City of Mississauga.

Modifying Engineering Standards

SP12

FACTSHEET



DESCRIPTION

Changes to engineering standards to allow use of and promote natural drainage systems and grassed waterways which reduce pollutants near the source through absorption and filtration of pollutants. Reduce runoff through encouraging infiltration.

APPROACH

Promote the use of surface storage and drainage (through grassed areas). Use grading standards to promote surface ponding and/or increase the detention time of surface water on grassed areas. Reduce the minimum and maximum surface slopes and provide retention areas. Change road design standards to promote roadside swales. These can include measures that promote infiltration such as rock or stone filled bases for trenches.

Care must be exercised in applying infiltration methods that might cause contaminated water to enter aquifers. Infiltration methods are best applied to residential drainage, and for rooftop drainage from other areas. Water should not be infiltrated from commercial or industrial rooftops that have building ventilation systems that release gases from volatile petroleum.

Engineering standards have to be changed to allow for alternatives to roadside ditches

BENEFITS

- **General:** Nearby drains and watercourses will be protected from sediment loads during rainstorms, preventing negative impacts on water quality. There may be some reduction in flow volumes.
- **Pollutants Reduced:** Reduced pollutants entering storm drains and local waterways from roadways include sediment, nutrients, oil, antifreeze, rubber and other vehicle residues.
- **Beneficial Uses Improved:** Aesthetics, water quality, and aquatic life.

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

FACTSHEET

Modifying Engineering Standards

REQUIREMENTS

- **Cost Implications:** Roadside ditches have been used historically, and are currently applied in some municipalities. Grassed swales have been evaluated for effectiveness. Some research has concluded that capital and operating costs are lower for roadside ditch applications than for conventional curb and gutter systems combined with conventional storm sewers.
- **Program Support:** Municipal staff support will be needed through the planning process to encourage developers or municipal operations managers to make the necessary modifications.
- **Equipment:** Equipment needs will be dependent on the type of measure used, and the amount of landscaping or construction required.
- Policy/By-laws: Will require the revision to engineering standards and site plan standards (and approval process).

PUBLIC EDUCATION/ INVOLVEMENT

Many measures used with this type of source control will require public education for the acceptance of periodic surface ponding (and conveyance).

LINKAGES

- **Program:** Flow reduction; pollution prevention and control; Environmental Management System.
- **Related practices:** Alternate conveyance controls (roadside ditches); at source controls (storm gardens; surface storage/infiltration).

REFERENCES

J.F. Sabourin and Associates Inc. 1997 and 2000, *An Evaluation of Roadside Ditches and Other Related Stormwater Management Practices*, Second edition revised with cost analysis and selection tool, Published by Toronto and Region Conservation Authority.

Flow Reduction at Lot Level

The measures in this category provide flow reduction to the sewers or conveyance system and provide a corresponding reduction in overall pollutant loadings. Measures address both flows to the sanitary sewer system (water conservation methods) and the storm drainage system (to reduce flows to surface drainage and combined sewers). The measures outlined include:

FR1 **Water Conservation Program**
FR2 **Downspout Disconnection**
FR3 **Rain Barrel Programs**
FR4 **Storm Garden Development**
FR5 **Infiltration Measures on Site**
FR6 **Vegetation Measures – Buffers**
FR7 **Urban Forests**
FR8 **Roof Top Treatments**

Water Conservation Program

FR1

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Water conservation and water efficiency programs are used to reduce the volume of household and industrial water entering combined and sanitary sewers and wastewater treatment plants.

APPROACH

- Integrate efforts with naturalization and pesticide reduction programs for public lands;
- Integrate water efficiency planning into municipal water supply and wastewater treatment strategies;
- Use social marketing or educational programs for householders, businesses and industries to change water use habits and attitudes;
- Produce and distribute water conservation educational brochures and printed information;
- Develop media contacts, press releases and promotional events to promote water conservation;
- Integrate public outreach programs or publication development with agencies or organizations with a compatible agenda;
- Develop incentive programs to facilitate the installation of residential low flush toilets and water saving devices;
- Use metering and water pricing strategies to provide a cost saving incentive for the end user;
- Reduce operational water use on public parks and municipal lands;
- Promote alternative landscaping or gardening practices which reduce the need for summer peak watering;
- Develop industrial and commercial information materials, workshops and water audit kits to promote water efficiency in the workplace;
- Develop school programs and provide materials such as shower timers and small water saving devices. Incorporate a monitoring component as assigned homework; and
- Reduce water leaks where possible.

BENEFITS

- **General:** The total volume of water moving from households and industrial buildings through sanitary and combined sewers is reduced by a considerable margin. This lowers the risk of combined sewer overflows during rainy weather and improves the operating efficiency and long-term performance of wastewater treatment facilities and septic tanks. Water conservation programs also reduce the demand on groundwater resources especially in dryer seasons and provide a cost-saving benefit for industries and other large volume users.
- **Pollutants Reduced:** Pollutant loads in combined sewer overflows (CSO) and sewage effluents are reduced including bacteria, nutrients, and oxygen demanding substances.
- **Beneficial Uses Improved:** Swimming, aesthetics, contaminated sediments.
- **Performance:** The use of residential low-flow toilets in one case study area achieved a 20% to 30% reduction in water use. In the same monitoring program, it was found that toilet flow reduction devices achieved only up to a 9% reduction.

Low flow showerhead

Low flush toilet

REQUIREMENTS

- **Cost Implications:** The cost of public outreach programs will be determined by the type of outreach undertaken, the level of integration with other programs and the amount of volunteer help available. Water conservation can be incorporated into municipal operational

FACTSHEET

Water Conservation Program

policies and should result in long-term cost savings.

- **Program Support:** A staff person is needed to track, review and provide coordination of efforts. Other support will be determined by the type of water conservation program undertaken and the level of integration with related program services.
- **Equipment:** Municipal water use reduction may include the retrofitting or changing of public toilets, drinking fountains and other facilities. Industrial programs may require redesign of some operations and changes to existing facilities.
- **Policy/By-laws:** Water Use By-laws are in place in some municipalities specifically to control lawn watering and pool filling during drier seasons. Municipal operation policies may be used to promote maintenance practices that reduce water use on parks and other public lands. A water use surcharge may be used to "tap" large water users, with the funds used for water/sewer system maintenance, operation and rehabilitation.

PUBLIC EDUCATION/ INVOLVEMENT

- Public outreach and education is the most significant component of a water conservation program. This can range from providing information with utility bills to a major social marketing program to reach a specific reduction target.

LINKAGES

- **Program:** Pollution prevention and control, flow reduction program.
- **Related practices:** Xeriscaping (use of drought-tolerant plants), environmentally friendly lawn maintenance programs.

LIMITATIONS

The success of the program is dependent on voluntary actions by the public.

APPLICATION EXPERIENCE

A Master Plan for Water Efficiency is a large component of the Water Resources Protection Strategy for the Regional Municipality of Waterloo. The Master Plan sets water reduction targets for the next ten years and determines what programs will be carried out to achieve these. To date the Region has facilitated the retrofitting of 7,000 low flush toilets per year through a $50 per toilet rebate incentive. Other programs include Industrial Water Audit kits and assistance, publication materials, school programs and public information displays. A total budget of $520,000 has been allocated for the next five years for the Water Efficiency Program. Preliminary data from an American Water Association Research Foundation end user study shows that toilets are the heaviest year round residential water users, and water softeners are also large water users.

- The Watershed Infrastructure Ecology Program (WIEP) in Toronto included the "5 Things You Can Do" program framework, www.ilap.com/wilson/Don/WIEP/WIEP.html.
- The City of Toronto Go Low Flow Program incorporated water conservation retrofit devices. The cost for a basic kit of several small devices for public distribution is approximately $10.15 per kit, www.city.toronto.on.ca/water.
- The Region of Durham, Ontario has produced a Household Guide to Water Efficiency as public education material for their Water Efficient Durham program. For information contact Glen Pleasance, Coordinator at (905) 668-7721, or 1-800-372-1103.

REFERENCES

Eco-Efficiency Resource Manual, EDCO. Trish Johnson Cover. Water Efficiency Branch, Environmental Services Department. Ottawa-Carlton Centre, Cartier Square, 111 Lisgar Street, Ottawa, ON K2P 2L7.

Ontario Water Works Association, 1999. *Water Efficiency: A Guidebook for Small and Medium-sized Municipalities in Canada.*

Downspout Disconnection

FR2

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Downspout disconnection describes the practice of disconnecting roof leader downspouts from the storm, sanitary or combined sewer system.

Flow is redirected to a grassed or vegetated area, soak-away pits, or stored in rain barrels. Storm water directed to grassy or planted areas can be used by the vegetation (evapotranspiration), or may percolate into the ground, eventually to discharge as a groundwater spring into a local creek.

Any surface flow, which may still reach the storm sewer system will be filtered by the grassed surfaces and carry less pollutants to the surface streams.

APPROACH

Many municipalities passed sewer use by-laws in the late 50's or early 60's to prevent foundation drains or weeping tiles from draining into the sanitary sewer system. This coincided with a change in the Ontario Building Code. Typically connections installed prior to passage of such by-laws are exempt from the by-law.

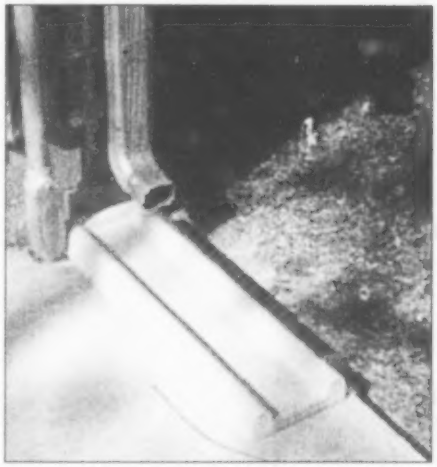
St. Catharines, Ontario has passed a by-law (By-law 91-364) to regulate sanitary and storm drainage, which prohibits connection of roof downspouts to sanitary/combined sewers without exemption; however, foundation drains connected prior to the by-law may remain connected. A grant program is available to subsidize foundation drain disconnection in areas subject to basement flooding.

For voluntary disconnection programs, residents must be convinced that the measure is beneficial, and preferably at no or minimal cost to them. For mandatory programs, by-law enforcement becomes a necessity, since lack of enforcement could leave the city liable for flood damages.

In general, lot size and soil types affect the application and success of this method.

Specific Criteria

- Lawn to lot area ratio should be greater than 0.5.
- Lot grading slope should be gentle.
- Low density residential areas preferred.
- Sandy soil is preferred but is not essential to success.



Downspout disconnect and redirected to ground

- Ground water table should be more than 2.5 metres below grade.
- Linkage to other measures that can offset some limitations (e.g. rain barrels, soak-away pits).

Additional enhancements include provision of rain barrels and advice on storm gardens and on-site infiltration measures. (See the fact sheets on these related measures.)

With the City of Toronto program, residents that were willing to be disconnected received an inspection to see if the site was suitable. If suitable, the disconnection was carried out either by a private contractor or by the resident at no cost to the resident.

BENEFITS

- **General:** The disconnection will have varied benefits depending on the original connection and the use made of the water.

  Disconnection from the sanitary or combined sewer systems will:

  - reduce overflows of combined sewer overflows (CSOs) and sanitary sewers;
  - reduce basement flooding;
  - reduce treatment costs at the sewage treatment plant;
  - reduce costs and increase effectiveness of measures such as sewer separation, storage tanks and treatment systems;

FACTSHEET

Downspout Disconnection

provide additional benefits given below for storm sewer disconnection, if the water is not simply diverted to the storm sewer system.

Disconnection from the storm sewer will:

reduce heavy flow rates that cause channel erosion and flooding;

reduce the potential for flooding caused by storm sewer back-ups;

increase the amount of water available to the groundwater system;

increase the amount of baseflow in watercourses;

reduce pollutant loadings to local streams and rivers;

conserve water if rain barrels are used to store water;

provide water for lawns and gardens and enhancing natural systems.

- **Pollutants Reduced:** Sediment, Nutrients, Heavy Metals, Toxic Materials, Floatable Materials, Oxygen Demanding Substances, Oil and Grease, and Bacteria.
- **Beneficial Uses Improved:** Swimming, aesthetics, water and sediment quality, and aquatic life.
- **Performance:**

  The City of Toronto has achieved disconnection of approximately 8% of the households contacted by direct mailings in its voluntary disconnection program. Some of the residential properties could not be disconnected for reasons given below under "Limitations." As a result of the disconnections, the Western Beaches Storage Tunnel was reduced in size by 8% at a significant cost saving.

  In a demonstration study of non-structural stormwater management practices in an area of Toronto that was partially separated with the installation of road storm sewers, it was estimated that disconnection of 25% of existing downspouts would reduce the average number of remaining CSOs by 50%. Disconnection of 2/3 of downspouts would reduce the number of CSOs to less than one occurance per year, J.F. Sabourin and Associates Inc., 2000.

  The City of St. Catharines has achieved 95% compliance with a mandatory downspout disconnection program of 11,500 residential homes in targeted areas.

REQUIREMENTS

- **Cost Implications:** The average cost for disconnecting a private property in the City of Toronto was between $180 to $220 depending on the area where the property is located and the number of downspouts on the property. Mississauga has initiated a mandatory disconnection program for the Park Royal area to combat flooding at a per household cost of $100.
- **Program Support:** A total of eight full-time staff members were dedicated to the old City of Toronto program, involved in managing the program, developing and delivering public involvement materials, inspecting properties for disconnection and managing contracts with private contractors carrying out the disconnection work. Total cost of the program is $1.6 million annually.
- **Equipment:** Private contractors provide the equipment, typically associated with installation of roof eavestroughs and downspouts.
- **Policy/By-laws:** Many municipalities are reluctant to make disconnection of downspouts mandatory, because the connections were made legally, and because sewer use by-laws, which prohibit connection of downspouts to sewers for new development, often specifically exempt the older connections.

PUBLIC EDUCATION/ INVOLVEMENT

- Voluntary programs require extensive public involvement. The City of Toronto Program included: direct mailings of letters and brochures, posters at transit shelters, fridge magnets, videos, media coverage, and school curriculum development.

LINKAGES

- **Program:** Flow reduction, water conservation.
- **Related practices:** Rain barrels and cisterns, lot level infiltration, roof top storage, downspout disconnection by-law.

Downspout Disconnection

LIMITATIONS

- Inspections of properties in the City of Toronto of residents willing to disconnect revealed that 18% were unsuitable for disconnection because:
- there was no suitable discharge area;
- the property was graded towards the house;
- there were physical obstructions on the property;
- there was risk of flooding of neighbouring property;
- the downspout was shared with an adjacent property owner (semi-detached or multiple unit dwelling) who objected to the disconnection;
- there was an internal roof drainage system (schools);
- the property was close to a ravine;
- there was contaminated sub-soil;
- soil conditions were unsuitable (limited infiltration capacity); and
- the existing fascia board and/or eavestrough was in poor condition.

APPLICATION EXPERIENCE

- See City of St. Catharines and City of Toronto case studies, in Part III.

REFERENCES

- Shelley Grice, *The Development and Promotion of "Recycle Your Rain": A City of Toronto Lot Level Stormwater Diversion Initiative*, in Stormwater Technology Transfer Conference, Stormwater Assessment Monitoring and Performance Program, MOE, 1998.
- Werner Wichman, CSO control at Toronto's Western Beaches, in *Stormwater Technology Transfer Conference*, Stormwater Assessment Monitoring and Performance Program, MOE, 1998.
- Cindy Toth, *Best Management Practices – Program Implementation*, City of St. Catharines, in Stormwater Technology Transfer Conference, Stormwater Assessment Monitoring and Performance Program, MOE, 1998.
- J.F. Sabourin Associates, *Demonstration of Non-Structural Stormwater Management Practices – Implementation Plan Overview* – Moore Park/North Rosedale Demonstration Area, Oct. 1998.
- *Demonstration of Non-Structural Stormwater Management Practices*. J F. Sabourin and Associates Inc., 2000.

Rain Barrel Program

FR3

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Downspouts, also known as rainwater leaders, which when connected directly to the sanitary/combined sewer system, contribute to a major pollution problem at our beaches and in our creeks. Clean roof water discharge into the sanitary sewer can result in an overloaded system, which results in sewage discharge into local water bodies or household basements. An increased tax burden is also borne by the municipality faced with paying to treat an increased volume of sewage effluent. The use of rain barrels makes downspout disconnections possible in some areas where it would be difficult to disconnect.

APPROACH

The major problem areas are in homes found in the older parts of most cities. The sewers are undersized to accommodate the sewage flows and the increased wet weather flows attributed to the downspouts. In the case of combined sewer overflows (CSOs) the excessive flows outlet to a nearby drainage ditch or watercourse. If downspouts are removed in all of the sanitary/combined sewer areas, the frequency of CSOs could be reduced.

The introduction of rain barrels to store the volume of water, which previously went down the drain, provides a means of water conservation. The water collected can be used for watering plants, flowers, lawns and gardens. Some residents use their water for washing hair, laundry and cars.

A more costly method of storing larger volumes of water, including that generated by the weeping tiles around the foundation, is the installation of a cistern complete with a pumping system. In most cases the payback on the $5,000 investment to install such a system does not warrant the original investment.

BENEFITS

- **General:** Stormwater is diverted from the sanitary and combined sewers. Wastewater treatment facilities use controlled biological processes to treat sewage and the presence of sewage diluted with rainwater compromises the effectiveness of the treatment process. Rain barrels are attractive to many homeowners and can be used as an incentive to disconnect downspouts.

Downspout disconnected and redirected to a rainbarrel

- **Pollutants Reduced:** Sediment, Nutrients, Heavy Metals, Toxic Materials, Floatable Materials, Oxygen Demanding Substances, Oil and Grease, and Bacteria.
- **Beneficial Uses Improved:** The presence of sewage in a watercourse is reflected in the bacterial count. An acceptable count of 100 E. coli organisms per 100 milliliters of water is considered safe for swimming. Beaches are closed for counts in excess of this. Reducing the frequency of CSOs discharged into the watercourses will dramatically reduce the bacterial counts.
- **Performance:** Performance depends on the co-operation by the homeowners. To be effective the barrel must be empty at the beginning of

FACTSHEET

Rain Barrel Program

storm events. The most effective barrel is one that has a continuous slow discharge to a garden area. Rain barrels should not be used in the winter. Barrels in Toronto range from 225 to 565 litres. In combination with downspout disconnection, the application of rain barrels would result in a volume reduction of approximately 8.4% for a one year storm event, which in turn would reduce the volume of CSO storage requirements at the outlet.

REQUIREMENTS

- **Cost Implications:** Cost for subsidizing rain barrel purchase.
- **Program Support:** Program support staff need to make the assessments as part of a downspout disconnection program.
- **Equipment:** Rain barrels. It may be necessary to install an overflow to the sewers in some areas or a diversion valve to redirect winter flow.
- **Policy/By-laws:** Mandatory downspout disconnection programs can provide an incentive to use rain barrels.

PUBLIC EDUCATION/ INVOLVEMENT

- Public involvement is necessary in gaining acceptance in the voluntary use of rainbarrels. The primary message to deliver is the benefits of rainbarrels, plus the availability of rainbarrels from the municipality or private sector, and technical advice on installation and operation.

LINKAGES

- **Program:** Flow reduction, Water conservation.
- **Related practices:** Downspout disconnection, storm gardens.

LIMITATIONS

- During winter, the rainbarrels should be bypassed. A downspout bypass valve may be necessary at the connection point to the rain barrel.

APPLICATION EXPERIENCE/ REFERENCES

- City of St. Catharines
  Downspout Disconnection Campaign.
  Contact Cindy Toth,
  (416) 688-5600 Ext. 693 or (416) 935-2722.
- City of Toronto, Rain Barrel Pilot Project
  Contact Robert Klimas, (416) 394-8455.
- City of Toronto Downspout Disconnection Program
  Contact Ted Bowering
  (416) 338-5473

Storm Garden Development

FR4

FACTSHEET

This resident will have reduced pesticide, fertilizer and water use

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Reduction of stormwater volume entering the storm sewer system by on-site management practices, such as downspout disconnection with diversion to rainbarrels, ponds and infiltration areas. On-site management includes creating permanent or temporary ponds to hold stormwater for infiltration into the soil or evaporation to the atmosphere. Landscaping and plants suitable to the site conditions are used to facilitate absorption and transpiration. Other measures may include the use of perforated pipes or a soak-away pit to allow absorption; and the use of porous paving material or grassed areas to facilitate percolation of stormwater.

APPROACH

- Disconnect downspouts from storm sewer system and capture the roof water in constructed ponding areas, which provide long-term storage or short-term infiltration, depending on the site conditions and desired facility.
- Locate and avoid disruption of underground utilities such as telephone, hydro and gas lines.
- Protect basements, buildings, neighbouring properties, public sidewalks and roads with positive drainage. Ponds or infiltration facilities should be at least 3 metres from building walls.
- Use sufficient appropriate lowland vegetation to improve absorption and transpiration.
- Provide an emergency "spillway" for unusually heavy rainstorms.
- Be aware of by-laws and safety considerations regarding permanent standing water, especially for young children.
- Use natural or non-chemical insect and weed control to minimize soil and groundwater contamination.

BENEFITS

- **General:** The total volume of water moving from households and industrial buildings through sanitary and combined sewers is reduced by a considerable margin. This lowers the risk of combined sewer overflows during rainy weather and improves the operating efficiency and long-term performance of wastewater treatment facilities and septic tanks. Other benefits include recharge of local aquifers, and the improvement in water quality in local streams due to the filtering of contaminants and sediment. Bank erosion may be reduced with reduction of the volumes of stormwater into local watercourses.
- **Pollutants Reduced:** Reduction of volume of silt and chemicals washing from roadways to local streams and watercourses.
- **Beneficial Uses Improved:** Increased diversity of plants and wildlife species in urban areas. Improved property appearance, visual interest and aesthetics. Increased environmental

FACTSHEET

Storm Garden Development

education opportunities especially about the hydrologic cycle. Improved urban air quality due to the increased vegetation.

REQUIREMENTS

- **Cost Implications:** The cost of a storm garden creation will be determined by the type of project undertaken, the availability of volunteer labour and expertise, and the local site conditions. Storm gardens can be effectively incorporated into municipal, industrial and commercial landscaping projects. A household storm garden can be created at low cost with careful design and the use of native plants and seeds for landscaping.
- **Program Support:** The storm garden alternative can be incorporated as part of a downspout disconnection, water conservation or naturalization programs. Some staff hours should be dedicated to providing a resource for interested householders and to coordinate and monitor the success of demonstration projects. Other support can be determined by the level of integration with related programs and services.
- **Equipment:** Basic home gardening and landscaping equipment may be sufficient in many cases, depending on the aspirations of the homeowner or the site conditions. Some areas may require professional grading, landscaping and installation of perforated piping or porous paving.
- **Policy/By-laws:** Mandatory downspout disconnection by-laws can provide an incentive for homeowners to consider storm gardens as an alternative to rainbarrels. Some by-laws may be applicable regarding safety requirements for standing water of a certain depth, and the direction of water to neighbouring properties and roadways.

PUBLIC EDUCATION/ INVOLVEMENT

- Public outreach programs and available expertise are essential to create strong public support for urban storm gardens and other stormwater diversion measures. This can range from providing information with utility bills to a major social marketing program to reach a specific reduction target.
- Some public education is necessary on the relationship of plants to the hydrologic cycle, and the relationship of surface contamination to the health of the groundwater system. Participants will need access to clearly presented information about drainage, soil conditions, landscaping considerations and appropriate plantings.
- Volunteer involvement may be possible with municipal or school projects. Local horticultural or naturalists groups may be interested in working on demonstration sites, and providing advice on appropriate plantings.

LINKAGES

- **Program:** Flow Reduction.
- **Related practices:** Water conservation. Environmentally friendly gardening practices. Naturalization projects.

LIMITATIONS

- Some sites do not have the space or soil drainage conditions to make storm gardens a feasible project. Drainage plans must include protection of house foundations, neighbouring plantings, properties, public walkways and roads.
- Other considerations include public perceptions about the safety and health hazards of standing water, for example, mosquito breeding areas, or deeper ponds posing drowning hazards for small children. Algal growth may also be perceived an undesirable product in some storm gardens, although mitigative measures are available and public education may dispel some misconceptions.

REFERENCES

- *Development of Brochure Information for Storm Gardens*. Prepared for the Rain Water Diversion Program, City Works Services, City of Toronto, by David Orsini and Associates, December 1997.

Infiltration Measures On Site

FR5

FACTSHEET

Type of Measure
FLOW REDUCTION
SOURCE CONTROL
DRAINAGE SYSTEM CONTROL
Program Element
RESIDENTIAL
COMMERCIAL ACTIVITY
INDUSTRIAL ACTIVITY
MUNICIPAL ACTIVITY

DESCRIPTION

Infiltration practices are encouraged as a best management practice to increase the infiltration of rainwater. The practice is primarily applied to mitigate infiltration loss with the increase in impervious cover. The method is also used to increase infiltration in areas where groundwater supply is to be augmented (i.e. for water supply or seepage to streams).

Infiltration is provided through either surface or subsurface measures. Surface measures include ponding areas, infiltration basins and trenches. Subsurface measures include soak-away pits, subsurface trenches, and pervious pipes.

Flows to infiltration systems generally require sediment removal systems to reduce maintenance requirements.

APPROACH

The effectiveness of this measure is dictated by the permeability of the soil and sediment removal prior to flows entering the facility. Groundwater protection is of concern depending upon contaminants in the surface flows and groundwater protection requirements.

Specific Criteria

Criteria to be used in the application of infiltration measures are available in various documents. Effectiveness is primarily dependent upon soil permeability and requires soils testing. Specific criteria are provided in several references such as Sabourin (1997) and Ferguson (1994).

To account for blockage of infiltration basins and trenches, some agencies only calculate infiltration through the sides of the facility to determine the infiltration capacity.

BENEFITS

- **General:** The effectiveness of this measure is dependent upon permeability, groundwater level and depth to bedrock as well as control of sediment in flows.

  Overall benefits are as follows:

  - Reduced volume of inflow to a storm or sanitary sewer system;
  - Reduced combined sewer overflows (CSOs);

Soak-away pit for downspout disconnect

  - Reduced sanitary treatment costs (with combined sewers);
  - Provides recharge to groundwater to replenish groundwater levels, water supply and groundwater flows to surface water such as springs feeding streams and wetlands;
  - Reduced erosion in streams.
  - Pollutants Reduced: Will reduce pollutant loadings associated with surface runoff.
- **Beneficial Uses Improved:**
  - Maintain groundwater supply sources.
  - Protect low flows in streams.
  - Reduce flows in sewers.
- **Performance:** This depends on many variables, e.g. soil type, slope, intensity of rain, etc.

REQUIREMENTS

- **Cost Implications:** Requires capital cost for installation and maintenance. Sediment control facilities should be provided upstream of facility (e.g. catchbasins or sediment forebays). Capital costs reported from Sabourin (1997) included:
  - Costs of basins in the order of $28/cu.m of storage;
  - Cost of infiltration trenches $20,000/ha;
  - Cost of multi pipe exfiltration system $1,000/m.

  All facilities will require a regular maintenance program primarily for sediment removal.

FACTSHEET

Infiltration Measures On Site

- **Program Support:**
  - Maintenance includes removal of accumulated trash every 6 to 12 months;
  - Infiltration bed may require sediment removal unless inflow has a pre-treatment sediment removal system;
  - Sediment disposal costs could be high if sediment is contaminated;
  - Vegetation should be kept to height below 450 mm.
- **Equipment:**
  - Vegetation maintenance equipment;
  - Trash removal equipment;
  - Sediment dredging and trucking;
  - Sewer flusher/truck mounted vacuum excavators for sediment removal.
- **Policy/By-laws:**
  - Related to sewer and stormwater management system design requirements;
  - Groundwater protection, especially around wellheads;
  - Easements will be required over infiltration facilities.

PUBLIC EDUCATION/ INVOLVEMENT

- Sample devices such as soak-away pits can be applied in residential areas. Residents should be informed about the devices and educated as to proper maintenance.
- Education program will assist in community acceptance of lot-level controls on private property or facilities located in areas of high public use.

LINKAGES

- **Related Practices:** Stormwater management; sediment control; roof leader disconnection; reasonable use guideline.

LIMITATIONS

- Effectiveness is highly dependent upon sediment control facilities since infiltration media can be easily plugged.
- Design life is lengthened significantly by accounting for horizontal infiltration only.
- Low permeability soil limits use of this practice.
- High groundwater levels and/or bedrock near the surface limits applicability.
- Protection of groundwater quality must be considered.

APPLICATION EXPERIENCE

- The City of Waterloo includes provisions in the design of entire subdivisions to require that the downspouts and foundation drains (connected to a sump pump) outlet to a "dry well" or "soak-away pit".

REFERENCES

- J. F. Sabourin and Associates Inc. 1997, *An Evaluation of Roadside Ditches*, Toronto Region Conservation Authority.
- Ferguson, Bruce K. *Stormwater Infiltration*, CRC Press, 1994.
- MOE, 1994, *Stormwater Management Practices Planning and Design Manual*, and updates.
- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.
- *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMP's*, Metropolitan Washington Council of Governments, 1987.

Vegetation Measures – Buffers

FR6

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

The practice of leaving areas next to environmentally significant areas, steep slopes, watercourses and previously manicured areas of parks in natural conditions, without mowing or treatment with pesticides or herbicides.

The purpose of this best management practice (BMP) is to provide several environmental benefits including decreased sediment and other pollutants in runoff, increased infiltration, improved habitat for wildlife and protection of watercourses from thermal impacts. In addition, since the areas receive no mowing, the measure minimizes transportation of clippings and cuttings into the stormwater conveyance system.

APPROACH

Vegetation control typically involves a combination of mechanical methods and careful application of chemicals (herbicides, pesticides and fertilizers). Mechanical vegetation control includes leaving existing vegetation, cutting less frequently, hand cutting, planting low-maintenance native vegetation, and educating employees and the public. The following are areas of concern:

- Steep slopes,
- Vegetated drainage channels,
- Creeks,
- Areas adjacent to catchbasins and,
- Detention/retention basins.

BENEFITS

- **General:** Clippings/cuttings carried into the stormwater system and receiving streams can degrade water quality in several ways. Suspended solids will increase causing turbidity problems. Since most of the constituents are organic, the biological oxygen demand will increase causing a lowering of the available oxygen to animal life. In areas where litter and other solid waste pollution exists, toxic materials may be released into receiving streams resulting in degradation of water quality. Runoff flow is reduced through infiltration and evapotranspiration.
- **Pollutants Reduced:** Sediment, Nutrients, Floatable Materials, Oxygen Demanding Substances.

Vegetation alongside a watercourse to provide environmental benefits

- **Beneficial Uses Improved:** Aesthetics, aquatic life.
- **Performance:** Woodward and Rock (1991) showed 60% or better removal of both phosphorus and sediment within a 50 ft grass strip.

REQUIREMENTS

- **Cost Implications:** Minor costs may be incurred to modify certain mowing equipment to pick-up clippings or mulch and leave in place. Clippings/cuttings on flat surfaces are generally not transported by stormwater run-off unless the event is particularly intense.
- **Program Support:** Maintenance activities should be co-ordinated to avoid cutting vegetation at drainage facilities when heavy rainfalls are anticipated.
- **Equipment:** Landscaping equipment for buffer maintenance.

FACTSHEET

Vegetation Measures – Buffers

- **Policy/By-laws:** Local municipal antidumping by-laws can be used to ensure that when vegetation is controlled by cutting or removal, the waste is disposed of properly. The "Topsoil Preservation Act" provides municipalities with the ability to pass by-laws to control the limits on exposure of soil after removal of vegetation. In an effort to meet solid waste reduction goals, many municipalities require or encourage composting yard waste instead of landfill disposal. For this purpose, some municipalities even offer a separate yard waste pick-up.

PUBLIC EDUCATION/ INVOLVEMENT

- Measures to improve the disposition of clippings/cuttings are simple and inexpensive. For the most part, the solution to this problem involves behaviour modification through education. Educate the public about careful use of or alternatives to herbicides, proper disposal of clippings and cuttings, and the effect of erosion from exposed soil. Residents should be encouraged to purchase mulching lawn mowers.

LINKAGES

- **Related practices:** Alternative landscaping. Grassed waterways.

LIMITATIONS

- The public may not find existing, natural or low-maintenance vegetation as attractive or desirable as ornamental or higher maintenance vegetation.

APPLICATION EXPERIENCE

The City of Waterloo West Side and Clair Creek developments use extensive buffering of natural areas including woodlots and wetlands and storm water drainage facilities. A book "Living With Nature in West Side Waterloo: A Good Neighbours Guide, is given to all new homeowners in the area. It is also available on request from the City of Waterloo, 100 Regina Street South, Waterloo, ON N2J 4A8. Website: www.oceta.on.ca/city.waterloo

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.
- S.E.Woodward and C.A.Rock, *The Role of Natural Buffer Strips in Controlling Phosphorus and Sediment Runoff*, #AC91-044-004, WPCF 1991 Conference Proceedings.
- MOE, 1994, *Stormwater Management Practices Planning and Design Manual*, and updates.

Urban Forests

FR7

FACTSHEET

DESCRIPTION

The practice of planting trees in urban areas to achieve a high level of tree canopy cover for multiple benefits, including stormwater flow reduction. Tree leaves intercept rainfall and release it slowly to the surface, while retaining a portion that evaporates later. The shade provided by trees cools the surface and produces a micro-climate that is attractive for residents. Wildlife is protected.

APPROACH

- Trees in our urban environment provide numerous benefits in maintaining the natural hydrologic cycle, such as capturing an initial portion of runoff, sheltering natural areas from erosion, and increased infiltration and evapotranspiration (water given off to the atmosphere as the tree grows).
- Methods developed by American Forests can quantify the hydrologic benefit of existing trees and of enhanced tree cover in the urban ecosystem. The method called "urban ecological analysis" is carried out by a software package called CITYgreen, which utilizes computer maps of an area in a geographical information system (GIS). The analysis then can be used to justify additional investments in tree planting.
- American Forests recommends a goal for tree canopy cover in urban areas of 40%, broken down into 15% for business districts, 25% for urban residential, and 50% for suburban.
- Tree planting can be encouraged for individual residents and institutions, school boards, commercial and industrial sites.
- Public participation in tree planting programs for vacant public lands are a good way to raise awareness and achieve increased tree cover.

BENEFITS

- **General:** Trees provide benefits in energy conservation and reduction in the production of greenhouse gases. Aesthetics and wildlife habitat is improved. The goal of environmental sustainability of a community is enhanced.
- **Beneficial Uses Improved:** Flow reduction benefits include: reduced flooding and erosion; reduced overflows and treatment costs for combined sewer conditions; and reduced need for stormwater retention systems (storage ponds or tunnels).

An urban forest can enhance a communities environmental sustainability

REQUIREMENTS

- **Program Support:** Parks departments and conservation authorities often have tree experts on staff and can provide help in choosing hardy native trees for urban landscaping and specific applications.
- **Equipment:** The planning and analysis of urban forest programs is enhanced by use of a geographical information system (GIS) based software package. Advanced computer systems with graphic capabilities are required.
- **Policy/By-laws:** Policies to encourage tree planting by residents, and commercial and industrial facilities can be incorporated into the planning process of the municipality. Tree protection by-laws can reduce unnecessary tree removal during development and redevelopment.

PUBLIC EDUCATION/ INVOLVEMENT

- Programs to encourage public involvement in tree planting programs have usually been successful. Involvement of students, service clubs and scouting groups are encouraged.

Type of Measure
FLOW REDUCTION
SOURCE CONTROL
DRAINAGE SYSTEM CONTROL
Program Element
RESIDENTIAL
COMMERCIAL ACTIVITY
INDUSTRIAL ACTIVITY
MUNICIPAL ACTIVITY

FACTSHEET

Urban Forests

LINKAGES

- **Program:** Parks management, flow reduction, planning department, conservation authority valley and stream management.
- **Related practices:** Natural drainage systems.

APPLICATION EXPERIENCE

- American Forests applied the CITYgreen software to the City of Milwaukee. The current tree canopy of 18% was calculated to be worth $305 million, in terms of the equivalent storage required to capture the flow from a two-year storm. This water volume was estimated to be captured by the existing tree canopy. If Milwaukee increased its canopy cover to the goal of 40%, additional stormwater benefits of $202 million were estimated. In addition, an air pollution reduction benefit of $18 million was estimated for the increased canopy.
- Kitchener has a program to renew its urban forest by subsidizing purchase of trees for private properties – contact the City of Kitchener at 519-741-2557
- City of Mississauga has adopted a Tree Permit By-law to regulate the removal of trees from private property. Contact City of Mississauga at 905-615-4569.

REFERENCES

- Brochures – Project Green, 477 Pelissier Street, Suite 7, Windsor, Ontario, Canada N9A 4L2. Website: www.greencanada.agora.ca
- *The State of Our Urban Forest: Assessing Tree Cover and Developing Goals*, Sept. 1997. American Forests, PO Box 2000, Washington DC 20013. Website: www.amfor.org

Rooftop Treatments

FR8

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

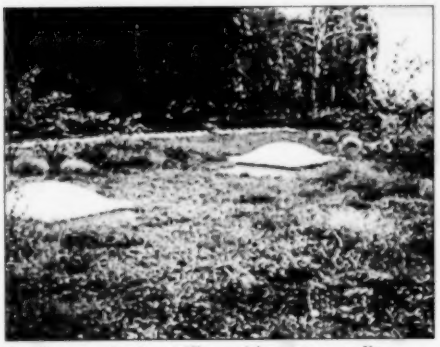
The use of flat rooftops for storage of rainwater and for rooftop vegetation including gardens.

APPROACH

Flat building roofs can be used to store the rain that falls on them and to reduce peak flow rates of runoff to storm sewer systems. Rooftop storage has been used for several decades as a peak flow control. There are few water quality, erosion control or water balance-type benefits achieved by utilizing this type of storage on building roofs. However, site servicing and storm drainage costs can be reduced through reduced downstream storm sewer sizes and such systems contribute to flood control objectives. Rooftop storage is economical when addressed at the building design stage and requires little extra cost during construction.

Traditional rooftop storage is applicable to large flat commercial and industrial rooftops, and in some cases, residential apartment/condominium development. Peaked roofs offer few opportunities for storage. Rooftop storage is widely applied for infill development scenarios to mitigate the need for downstream storm sewer size increases. This control storage is highly effective in reducing downstream peak flow rates. The volume of storm runoff to the sewer system is not reduced as discharge occurs over a much longer duration.

Rooftop gardens (an extension of the traditional storage techniques) are a relatively recent innovation in the field of stormwater management. They are typically designed to capture runoff from smaller storms than traditional rooftop storage systems. They are therefore more oriented towards providing water quality, erosion and water balance-type benefits. Rooftop gardens may be as simple as installing a layer of soil medium and establishing turf to create a sodded roof which retains water in the soil medium and provides filtration. They can also be more elaborate, involving a fully landscaped area with trees, shrubs, gardens, fountains, seating areas and other outdoor amenities. At both extremes of the range, rooftop garden stormwater management is an integral design objective. The range of plants suitable for use in rooftop landscapes in limited by the extremes of microclimate of the rooftop setting, including high wind, low winter



Rooftop gardening will provide water quality, erosion and water balance benefits

temperature due to lack of ambient heat which is retained in the ground in at-surface situations, and drought. As a result, alpine or sub-alpine species are well suited to rooftop applications. In more elaborate schemes, infrastructure such as irrigation systems, increased insulation and venting from interior heat sources can be employed to overcome limitations imposed by adverse microclimate conditions. Rooftop gardens have been used extensively and successfully in Europe and their performance is well documented.

"According to European studies, rooftop gardens retain 70 to 100% of precipitation that falls on them in summer and about half that in winter – storing it until it is taken up by plants and returned to the atmosphere through evapotranspiration. Studies have shown that plants act as a natural filter for runoff – removing up to 95% of heavy metals such as cadmium, copper and lead" (Environment Canada, 1999).

BENEFITS

- **General:** Storage of rainwater on rooftops will reduce flow to the storm or combined sewer system in wet weather. This may reduce the effects of excess flows, such as flooding, channel erosion, and combined sewer overflows. Rooftop gardens will also reduce pollutant loadings from rooftops.
- **Beneficial Uses Improved:** Flow reduction reduces: flooding and erosion; overflows and treatment costs for combined sewer conditions; and need for stormwater retention systems (storage ponds or tunnels).

FACTSHEET

Rooftop Treatments

REQUIREMENTS

- **Cost Implications:** No additional cost associated with option when applied in new, infill and redevelopment situations (assumes extra costs are part of the normal stormwater requirements or are based on lifestyle/amenity considerations).
- **Other:** Local building requirements should be consulted since not all municipalities may allow these practices.

LINKAGES

- **Program:** Flow reduction, downspout disconnection.
- **Related practices:** Rain barrels, storm gardens, urban forest.

LIMITATIONS

- Rooftop storage primarily applies to new construction involving structures with flat roofs. Retrofit is difficult because of structural load requirements and potential building modification costs (e.g. piping, etc).
- Rooftop garden effectiveness is design-dependent.

APPLICATION EXPERIENCE

- Traditional rooftop storage is an effective peak flow control and is accepted by some conservation authorities (e.g. Toronto and Region Conservation Authority) as part of stormwater management strategies (for flood control).

REFERENCES

- City Farmer. www.cityfarmer.org/
- Environment Canada, Science and Environment Bulletin. "Green Skylines offer urban re-leaf". www.ec.gc.ca/science/sandejuly99/article2_e.html
- Rooftop Gardens Resource Group, 14 Sackville Place, Toronto, ON M4X 1A4. www.interlog.com/~rooftop/

Municipal Operations Measures

These measures focus on the operations of municipalities in maintaining and rehabilitating infrastructure systems such as the sewer systems, roadways and public lands such as parks. The measures outlined include:

MO1 **Sewer Use By-law**
MO2 **Road De-icing/Salt Application**
MO3 **Leaf Cleaning/Removal**
MO4 **Street Cleaning**
MO5 **Catchbasin Cleaning**
MO6 **Storm Drain Flushing**
MO7 **Municipal Yard Operation**
MO8 **Municipal & Residential Housekeeping Practices**
MO9 **Tank Spill Prevention and Control**
MO10 **Illicit Connection to Storm Sewer – Prevention and Detection**
MO11 **Leaking Sanitary Sewer Control – Combined and Sanitary (exfiltration)**

Sewer Use By-laws

MO1

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Ontario municipalities may pass by-laws for prohibiting, regulating and inspecting the discharge of any gaseous, liquid or solid matter into land drainage works, private branch drains and connections to any sewer, sewer system or sewage works for the carrying away of domestic sewage or industrial wastes or both, whether connected to a treatment works or not. This authority is provided under Section 210, paragraph 150 of the Municipal Act.

APPROACH

Sewer use by-law requirements vary by local municipality. The by-law can be an effective tool to encourage industries and commercial facilities to prevent pollution because it can:

- prohibit discharges of hazardous waste;
- specify numerical discharge limits e.g., metals, organics, suspended solids, and biological oxygen demand.

BENEFITS

- **General:** Control of discharges to storm, sanitary and combined sewers will reduce loading to sewage treatment plant and environment. Sewer use programs can encourage pollution prevention by increasing awareness of pollutants of concern as well as providing incentives to control discharges and avoid penalties.
- **Pollutants Reduced:** Metals, Organics, Suspended Solids, Biochemical Oxygen Demand (BOD),Toxic Materials, Floatable Materials, Oil and Grease, Bacteria, Nutrients.
- **Beneficial Uses Improved:** Swimming, aesthetics, contaminated sediments, aquatic life.
- **Performance:** Depends on the parameters, monitoring, enforcement, and education program of the municipality. Many municipalities are able to limit discharges of metal and organic chemicals so that biosolids can be applied to agricultural land.

REQUIREMENTS

- **Cost Implications:** Program costs for staff and equipment to monitor, enforce, and educate the public and commercial and industrial establishments.

Regular inspection and testing of sanitary sewers to ensure sewer use by-laws are followed

- **Program Support:**
  - Requires technical staff to establish local limits, detect and investigate violations, and co-ordinate public education.
  - Legal advice is required to establish by-laws and pursue prosecution of significant cases.
  - Administrative staff is required to maintain and update database of industrial sewer discharges and provide program support.
- **Equipment:**
  - Personal protective equipment;
  - Sampling containers and equipment;
  - Computers/database for records maintenance;
  - Laboratory facilities in house or under contract.
- **Policy/By-laws:**
  - Municipal Act;
  - Environmental Protection Act – Ontario Regulation 347;
  - Pesticides Act;
  - Ontario Water Resources Act.

FACT SHEET

Sewer Use By-laws

PUBLIC EDUCATION/ INVOLVEMENT

The general public should be made aware of the by-law and its enforcement by the municipality. This is an example of a positive program for which a municipality can take credit.

LINKAGES

- **Program:** Pollution Prevention / Environmental Management Systems.
- **Related practices:** Best Management Plans, Codes of Management Practice.

LIMITATIONS

Staff requirements to establish limits, monitor industry, and enforce limits. Costs of laboratory analysis.

APPLICATION EXPERIENCE

Over 250 municipalities in Ontario have sewer use by-laws. In Ontario, one of the most recent sewer use by-laws to be adopted was by the City of Toronto in 2000. By-law No. 457-2000 includes discharge limits for sanitary/combined sewers and storm sewers, and pollution prevention requirements (now Toronto Municpal Code Chapter 681).

REFERENCES

- Model Sewer Use By-law, MOE, 1988.
- Section 3.4 of this Handbook "Municipal Sewer Use By-law".
- City of Toronto Sewer Use By-Law. No. 457-2000, adopted June 2000 – now Toronto Municipal Code Chapter 681 – SEWERS.

Road De-icing/Salt Application

M02

FACT SHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Past practices for winter road maintenance on local residential streets included as common practice, waiting until 25mm or more of snow accumulated before beginning to plow and treat with chemicals which frequently led to the development of "pack". Removal of this compacted layer tightly bonded to the pavement is called de-icing. This technique usually requires a large quantity of chemical to work through the pack to reach the snow/pavement interface and break it up. Arterial and collector streets receive application of salt at an earlier stage of snowfall, often at the onset of snow, in order to maintain traffic safety.

Alternatively, application of anti-icing liquid chemicals on the dry pavement delays ice formation during a snowfall or temperature drop.

Regardless of the technique applied, the common goal of a winter operations program is to provide safe road conditions without losing sight of the cost implications and potential negative impacts to the environment due to misuse of chemicals.

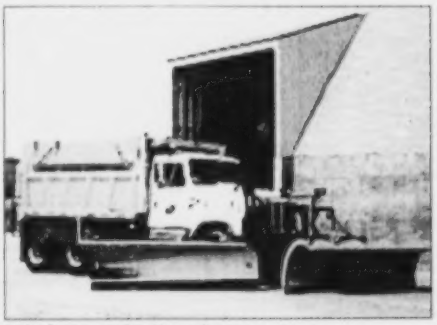
A recent review of road salts by Environment Canada (Priority Substances List Assessment Report – Road Salts, Environment Canada, August 2000) has recommended that "road salts", primarily sodium chloride, be considered "toxic" under Section 64 of the Canadian Environmental Protection Act 1999. This will place road salting under increasing scrutiny and increase the need for close management of operational practices.

APPROACH

The Ministry of the Environment Guideline B-4 Snow Disposal and De-Icing Operations in Ontario is provided to minimize the environmental impact of snow collection and disposal practices and de-icing operations. De-icing operational guidelines are as follows:

"The Ministry encourages the sensible and conservative use of sodium chloride and other de-icing compounds and recommends the following operational guidelines to be used by the road maintenance agencies:

- reduce de-icing chemical application rates to the minimum amount necessary to successfully perform the job. Experience has shown that an application rate in the order of 100 to 130 kg per km of two-lane road is sufficient;
- employ rate-controlled distribution equipment which applies de-icing chemical at the proper rate regardless of vehicle speed;
- apply de-icing chemicals on main thoroughfares and critical sections of the roadways only;
- where salt/sand mixtures are applied, incorporate into the admixture only enough salt to achieve desired results; and
- consider special protective measures when de-icing chemicals are applied to places in proximity to very salt sensitive areas (e.g. orchards, parks).



Salt dome and salt truck

- Level of Service – The extent to which maintenance services will be provided to a road section must be determined and preferably approved by municipal council.
- Determine techniques to be included in anti-icing program:
  - Consider Automatic Spreaders vs. Manual Controls to eliminate over and under spreading especially when truck speed is variable. Manual systems can be monitored and adjusted by the operator based upon truck speed, but such adjustments become a full-time job.
  - There are some advantages to the use of liquids at pavement temperatures above -5°C.
  - Pre-wetting of solid salt has been proven to keep more material on the road surface as opposed to being blown away by passing vehicles. Prewetting salt quickens its melting

FACTSHEET

Road De-icing/Salt Application

Warning motorists of icy conditions

action and if prewetted with liquid calcium chloride, enhances its melting effect at lower temperatures. Reductions in dry salt usage, which could be attributed to the effectiveness of prewetting with 32% liquid calcium at a rate of 4 to 8% by weight, ranged from 10 to 40%.

BENEFITS

- **General:** Excess use of salt causes corrosion of vehicles and structures, damages terrestrial vegetation and can pollute groundwater and surface water supplies (excessive sodium increases hyper-tension).
- **Pollutants Reduced:** Sodium chloride.
- **Beneficial Uses Improved:** Aquatic life.

REQUIREMENTS

- **Cost Implications:** Costs are dependent on the weather conditions, area to be serviced and the staff and equipment used for the task. Suitable storage areas must be provided for the de-icing materials and also vehicles for delivery of the materials.
- **Equipment:** Equipment includes vehicles with automatic or manual control spreaders, and any other road clearing equipment considered necessary for the area under consideration.

PUBLIC EDUCATION/ INVOLVEMENT

Public education is necessary to obtain support for snow management changes.

LINKAGES

- **Program:** Road maintenance.
- **Related practices:** Street cleaning, catchbasin cleaning.

LIMITATIONS

Reducing level of service may lead to increased risk of accidents and related liability for municipalities. Budget limitations may limit use of more expensive alternatives.

APPLICATION EXPERIENCE

City of Waterloo Program. The City of Waterloo Salt Reduction Program resulted in less salt usage through use of more effective control of the salt dosage systems in the salt spreader trucks.

The City of Toronto reviewed practices and alternatives to road salt in the early 1990s. Changing the plowing practices to favour more plowing and less salt reduced overall salt usage.

REFERENCES

- *Priority Substances List Assessment Report – Road Salts*, Environment Canada, August 2000.
- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Leaf Cleaning/Removal

M03

FACTSHEET

Vacuum truck and equipment for leaf removal

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Some reduction in the discharge of nutrients and pollutants to stormwater from street surfaces can be accomplished by conducting leaf cleaning/ removal during the fall season. The primary benefit of this activity is the removal of a high nutrient load from the storm sewer and ultimately the creek system, which enhances overall water quality.

APPROACH

The following approaches may be effective to implement and maintain a leaf pick-up program:

- Prioritize pick-up to use the most technically advanced sweepers or truck mounted vacuums designed especially for this activity, at the greatest possible frequency in areas with the greatest numbers of trees.
- Co-ordinate efforts to coincide with garbage pick-up, require that leaves be deposited loose at curb side or in bio-degradable paper bags suitable for composting.
- Keep accurate operation logs of tonnages collected to track program.

BENEFITS

- **General:** Improved water quality in local streams. Residents abutting channels will likely partake in a program as opposed to using the creek as a disposal site. Possible diversion of compostable materials from landfill sites.
- **Pollutants Reduced:** Sediment, Nutrients, Floatable Materials, Oxygen Demanding Substances.
- **Beneficial Uses Improved:** Aesthetics, aquatic life.

REQUIREMENTS

- **Cost Implications:** A leaf pick-up program requires a significant capital and Operating and Maintenance budget.
- **Program Support:** The following considerations may apply to the leaf pick-up best management practices (BMP):
  - Sweeper operators and maintenance staff, supervisory and administrative personnel are required.
  - Traffic control/by-law officers may be required to enforce parking restrictions.
  - Pick-up routes must be designed to optimize efficiencies.

FACTSHEET

Leaf Cleaning/Removal

Collected materials must be properly disposed. Composting is encouraged.

- **Equipment:** Mechanical broom sweepers are more effective at picking up leaves and large debris and cleaning wet streets. Provisions must be made for dumping as the on board storage fills quickly with the bulky material. Areas with heavy leaf deposits may be most easily cleaned with loaders and dump trucks or a tuck mounted vacuum system that discharges into the back of the truck.

PUBLIC EDUCATION/ INVOLVEMENT

- The general public should see the negative impacts of dumping yard wastes into abutting watercourses.
- Residents should be encouraged to dispose of leaf and yard waste in their own composters or by mowing and leaving on the lawn.
- Residents should be informed of leaf collection arrangements, such as location of leaf collection centres; use of 2-ply kraft paper yard bags instead of plastic; curbside collection dates; restrictions and proper methods of accumulation.
- Residents can benefit later by picking up the finished compost for their gardens.

LINKAGES

- **Program:** Road maintenance, Garbage collection, Municipal composting.
- **Related practices:** Street sweeping.

LIMITATIONS

The following limitations may apply to this BMP.

- Parked cars are the primary obstacles to effective program if leaves are deposited at curbside.
- The effectiveness may also be limited by traffic congestion, construction projects, and climatic conditions.
- There is some potential for danger of children playing and hiding in curbside leaf piles.

APPLICATION EXPERIENCE

- City of Kitchener 2000 Leaf to Compost Program, Public Works Department.

REFERENCES

- City of Kitchener, Department of Public Works (519) 741-2514 or www.city.kitchener.on.ca.
- *California Storm Water Best Management Practice Handbooks;* prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Street Cleaning

M04

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Some reduction in the discharge of pollutants to stormwater from street surfaces can be accomplished by conducting street cleaning on a regular basis. The primary and historical role of street cleaning is for sediment and litter control.

APPROACH

The following approaches may be effective to implement and maintain the street cleaning program:

- Prioritize cleaning to use the most technically advanced sweepers, at the greatest possible frequency in areas with the highest pollutant loading.
- Optimize cleaning frequency based upon interevent times (the dry period between storms). To achieve 30% removal of street dirt, the sweeping interval must be no more than 2 times the average interval between storms. To reach 50% removal, sweeping must occur 1 or 2 times during the average interval between storms.
- Conventional street cleaning may not have a very positive effect on stormwater quality because conventional street cleaners preferentially remove the large particles from the street. Valiron (1992) confirmed many earlier U.S. studies by showing that street cleaners only remove about 15% of the finest particles (less than 40 μ), while close to 80% of the largest particles (>2,000 μ) are removed.
- Increase sweeping frequency just before the rainy season.
- Keep in mind that proper maintenance and operation of sweepers greatly increases their efficiency.
- Keep accurate operation logs of curb miles swept and amount of waste collected to track program.
- Sutherland and Jelen (1996) have conducted tests using a new style street cleaner that show promise in removing large fractions of most of the street dirt particulates, even the small particles that are most heavily contaminated. The combination vacuum and brush sweeper tested is capable of much improved removal of fine particles from the streets compared to any other street cleaner ever tested. This machine was also able to remove large fractions of the fine particles even in the presence of heavy loadings of large particles. This is a built-in tandem machine, incorporating rotating sweeper brooms within a powerful vacuum head. Model analyses for Portland, Oregon indicate that monthly cleaning in a residential area may reduce the suspended solids discharges in the stormwater by about 50%, compared to only about 15% when using the older mechanical street cleaners that were tested during the early 1980s.

Note the heavy sediments picked up by the sweeper. Parked cars cause street sweeping problems street cleaning

BENEFITS

- **General:** Aesthetics. The maintenance program can reduce the amount of solid loadings to surface water.

FACTSHEET

Street Cleaning

This sweeper does a good job removing heavy sediments at spring cleanup

- **Pollutants Reduced:** Sediment, Nutrients, Heavy Metals, Floatable Materials, Oxygen Demanding Substances.
- **Beneficial Uses Improved:** Aesthetics, contaminated sediments, aquatic life.

REQUIREMENTS

- **Cost Implications:** A street cleaning program requires a significant capital and Operating Maintenance budget. Sweeper capital costs range from $85,000 to $140,000 (US$), with a useful life of about 4 years (Pitt, 1998).
- **Program Support:** the following considerations may apply to the street cleaning BMP:
  - Sweeper operators and maintenance staff, supervisory and administrative personnel are required.
  - Traffic control / by-law officers may be required to enforce parking restrictions.
  - Cleaning routes must be designed to optimize efficiencies.
  - Collected wastes must be properly disposed.
  - Operators require training in proper sweeper operation and technique.
- **Equipment:** Mechanical broom sweepers (more effective at picking up large debris and cleaning wet streets, less costly to purchase but generate more dust), vacuum sweepers (more effective at removing fine particles and associated heavy metals but ineffective at cleaning wet streets), combination sweepers and street flushers. Speeds of 10-15 km per hour are optimal. In addition, brush adjustment, rotation rate and sweeping pattern also affect removal efficiencies.
- **Policy/By-laws:** Densely populated areas or heavily used streets may require parking regulations to clear the street to accommodate street cleaning operation.

PUBLIC EDUCATION/ INVOLVEMENT

- The general public should be educated about the need to obey parking restrictions, to clean up after pets, and to reduce litter by using litter receptacles.

LINKAGES

- **Program:** Road Maintenance.
- **Related practices:** Catchbasin cleaning. Sewer flushing. Pet litter control.

LIMITATIONS

The following limitations may apply:

- There is currently no available conventional sweeper effective at removing oil and grease.
- Mechanical sweepers are not effective at removing fine sediment.
- Parked cars are the primary obstacles to effective street sweeping.

- Effectiveness may also be limited by street condition, traffic congestion, construction projects, climatic conditions and condition of curbs.

APPLICATION EXPERIENCE

- Normal street cleaning operations for aesthetics and traffic safety purposes are not very satisfactory from a stormwater quality perspective. These objectives are different and the removal efficiency for fine and highly polluted particles is very low. Unless the street cleaning operations can remove the fine particles, they will always be limited in their pollutant removal effectiveness. Some efficient machines are now available to clean porous pavements and infiltration structures, and new tandem machines that incorporate both brooms and vacuums have recently been shown to be very efficient, even for the smaller particles. Conventional street cleaning operations preferentially remove the largest particles, while rain preferentially removes the smallest particles. In addition, street cleaners are very inefficient when the street dirt loadings are low, when the street texture is coarse, and when parked cars interfere. However, it should also be noted that streets are not the major source of stormwater pollutants for all rains in all areas. Streets are the major source of pollutants for the smallest rains, but other areas contribute significant pollutants for moderate and large rains. Therefore, the ability of street cleaning to improve runoff quality is dependent on many issues, including the local rain patterns and other sources of runoff pollutants. More research is needed to investigate newer pavement cleaning technologies in areas such as industrial storage areas and commercial parking areas, which are critical pollutant sources.
- A study in Severn Sound found that some technologies are an efficient and cost effective stormwater management practice. Potential phosphorus reductions from stormwater of approximately 5% are achievable at less cost than most other traditional stormwater management practices.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.
- *Public Works Practices*, Robert Pitt, University of Alabama at Birmingham, March 30, 1998.
- Aaron Mattson, Severn Sound Remedial Action Plan, Urban Stormwater Management Strategy: Phase II – October, 1998.
- Sutherland, R.C. and S.L. Jelen. *Sophisticated stormwater quality modeling is worth the effort. In: Advances in Modeling the Management of Stormwater Impacts*. Edited by W. James. Computational Hydraulics International. Guelph, Ontario. 1996.
- Sutherland, R.C. *Studies show sweeping has beneficial impact on stormwater quality*. APWA Reporter. pp. 8 – 23. 1996.
- Valiron, 1992. *Usual techniques for stormwater pollutant removal in urban areas*. (In French), provisory report for the Seine-Normandie Water Agency.

Catchbasin Cleaning

M05

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

Vacuum truck for catchbasin cleaning

DESCRIPTION

Catchbasin and stormwater inlet maintenance should be done on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system and restore the catchbasin's sediment-trapping capacity.

APPROACH

Municipal staff should inspect public and private facilities on an annual basis to ensure compliance with the following:

- Catchbasins should be cleaned regularly enough to reduce the possibility of sediment and pollutant loading from the flushing effect of stormwater inflow. Cleaning should occur before the sump is 40% full.
- Prioritize maintenance to clean catchbasins and inlets in areas with the highest pollutant loading and in areas near sensitive water bodies. Ideally works should be scheduled just prior to the wet fall season to remove sediments and debris accumulated during the summer.
- Keep accurate operation logs of which catchbasins were cleaned and how much waste was removed to track program.
- Catchbasins with "goss traps" also capture oil and other floatable materials.

BENEFITS

- **General:** The maintenance program can reduce solid loadings to surface water and associated pollutants.
- **Pollutants Reduced:** Sediment, Heavy Metals, Floatable Materials, Oxygen Demanding Substances, Oil and Grease.
- **Beneficial Uses Improved:** Aesthetics, contaminated sediments, aquatic life.
- **Performance:** Basically, catchbasins remove the largest particulates that are washed from the watershed during rains, preventing them from being deposited in downstream sewerage and in the receiving water. If the catchbasins are full, they cannot remove any additional particulates from the runoff. Catchbasin sump particulates can be conveniently removed to restore the trapping of these particulates, and some of the runoff pollutants. Cleaning catchbasins twice a year was found to allow the catchbasins to capture particulates for most rains. This cleaning schedule was found to reduce the annual discharges of total solids and lead by between

FACTSHEET

Catchbasin Cleaning

10 and 25 percent, and chemical oxygen demand (COD), total Kjeldahl nitrogen, total phosphorus, and zinc by between 5 and 10 percent (Pitt and Shawley 1982).

Butler and Karunaratne (1995) gives the reported particle sizes trapped in gully pot sumps. The median particle size of the sump particles is shown to be between about 300 and 3000 µm, with less than 10% of the particles smaller than 100 µm, the typical upper limit of particles found in stormwater. Catchbasin sumps trap the largest particles that are flowing in the water, and allow the finer particles to flow through the inlet structure. Relatively few pollutants are associated with these coarser solids found in the sumps, compared to the finer particles.

REQUIREMENTS

- **Cost Implications:** An aggressive catchbasin cleaning program could require a significant capital and operating and maintenance budget because of the typically large number of catchbasins in any given area and the high cost of labour and equipment required to do the work.
- **Program Support:** The following administrative and staffing considerations may apply.
  - Two-person teams are required to clean catchbasins with vacuum trucks.
  - Arrangements must be made for the proper disposal of the collected wastes.
  - Crews must be trained in proper maintenance, including record keeping, disposal and safety precautions.
- **Equipment:** Truck mounted vacuum excavators are normally used for this activity. Smaller municipalities may elect to contract this work out as an annual contract.
- **Policy/By-laws:** There are no regulatory requirements for this best management practice (BMP). Municipal by-laws should prohibit the disposal of soil, debris, refuse, hazardous waste and other pollutants in the storm sewer system.

PUBLIC EDUCATION/ INVOLVEMENT

- Educate contractors (cement, masonry, painting) and utility employees (telephone, cable, gas and hydro) about proper waste (solid and liquid) disposal.

LINKAGES

- **Program:** Sewer system maintenance.
- **Related practices:** Street sweeping. Sewer flushing.

LIMITATIONS

- The metal content of decanted liquids and solids cleaned from catchbasins should be periodically tested to determine if the liquid violates limits for disposal to the wastewater treatment plant or if the solids would be classified as a hazardous waste.

REFERENCES

- *Public Works Practices*, Robert Pitt, University of Alabama at Birmingham, March 30, 1998
- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.
- Butler, D. and S.H.P.G. Karunaratne. "The suspended solids trap efficiency of the roadside gully pot." *Wat. Res.* Vol. 29, No. 2. pp. 719-729. 1995.
- Pitt, R. and G. Shawley. *A Demonstration of Non-Point Source Pollution Management on Castro Valley Creek*. Alameda County Flood Control and Water Conservation District (Hayward, CA) for the Nationwide Urban Runoff Program, U.S. Environmental Protection Agency, Water Planning Division, Washington, D.C., June 1982.

Storm Drain Flushing

M06

FACTSHEET

Type of Measure
- FLOW REDUCTION
- SOURCE CONTROL
- DRAINAGE SYSTEM CONTROL

Program Element
- RESIDENTIAL
- COMMERCIAL ACTIVITY
- INDUSTRIAL ACTIVITY
- MUNICIPAL ACTIVITY

DESCRIPTION

A storm drain is "flushed" with water to suspend and remove deposited materials.

APPROACH

Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive build-up. In some instances, it may be necessary to acquire the existing conditions data with "closed circuit television" (CCTV) inspection.

- Whenever possible, flushed effluent should be collected and pumped to the sanitary sewer for treatment.

BENEFITS

- **General:** Flushing is particularly beneficial for storm drains with grades too flat to be self-cleansing. Flushing helps ensure pipes convey design flow and removes pollutants from the storm drain.
- **Pollutants Reduced:** Sediment, Nutrients, Heavy Metals, Oxygen Demanding Substances, Bacteria
- **Beneficial Uses Improved:** Swimming, aquatic life.
- **Performance:** The practice is a regular maintenance activity primarily directed at build-up of sediment in sewers that would cause conveyance performance to drop. Sediment removed from the sewer represents a decrease in loading to the environment.

REQUIREMENTS

- **Cost Implications:** Unless flushing to a dry/wet detention area, the collection of liquid and sediments may be costly in terms of pollutant removal benefits.
- **Program Support:**
  - Minimum two-person teams needed for routine sediment removal and flush water collection.
  - Equipment operators also required.
- **Equipment:**
  - Water source (water truck, fire hydrant).

Sewer cleaning crew with a hydraulic jetter trailer

- Sediment collector (vacuum truck, dredge).
- Inflatable devices to block flow.
- Sediment/turbidity containment/treatment equipment required if flushing to an open channel.
- **Policy/By-laws:** Municipal by-laws should include sections prohibiting the discharge of soil, debris, refuse, hazardous waste and other pollutants that may hinder the designed conveyance capacity of the storm drain system.

PUBLIC EDUCATION/ INVOLVEMENT

- If large scale flushing activities are undertaken, local residents should be informed in advance.
- The public should be educated about the purpose of storm drains and the problems created by illegal dumping.

FACTSHEET

Storm Drain Flushing

LINKAGES

- **Program:** Sewer system maintenance.
- **Related practices:** Catchbasin cleaning, Street sweeping.

LIMITATIONS

These limitations may apply:

- Flushing is most effective in small diameter pipes.
- The availability of sufficient water and pressure to do the job must be ensured. A truck-mounted sewer flusher may be required to move the sediments.
- Personnel may have difficulty finding a downstream collection area for the sediments. A vacuum excavator may be required to pump the flows out of a downstream manhole.
- The flushed liquids and sediments must be properly disposed.
- Disposal of flushed effluent to the sanitary sewer may be prohibited in some areas because of inflow capacity and water quality concerns of the local wastewater treatment plant.

APPLICATION EXPERIENCE

XCG Consultants (1999) recommended a program of sewer flushing to reduce bacterial pollution loads to the Bay of Quinte in a recent pollution control planning study.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.
- XCG Consultants. 1999. City of Trenton Pollution Control Planning Study – Phase 2 – Final Report. Report prepared for Quinte Conservation, the City of Trenton and Environment Canada Great Lakes 2000 Cleanup Fund.

Municipal Yard Operation

M07

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Municipal works yard operations can include the storage of soil, cold mix asphalt, sand, salt and construction rubble. Other yard activities include vehicle repair and the washing of equipment. This best management practice (BMP) covers prevention and cleanup of spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials and training employees.

APPROACH

Vehicles and equipment will leak and spill fluids. The key is to reduce the frequency and severity of leaks and spills and, when they do occur, prevent or reduce the environmental effects. The following considerations may be effective:

- Perform fluid removal and changes inside or under cover on paved surfaces.
- Keep equipment clean; don't allow excessive build-up of oil and grease. Wash water to be properly filtered and disposed.
- Inspect equipment and storage yard on a regular basis. Carry out corrective measures immediately.
- Properly store hazardous materials and waste.
- Recycle greases, used oil and filters, antifreeze, cleaning solutions, automotive batteries, hydraulic and transmission fluid.
- Have spill cleanup supplies readily available.
- Use dry cleanup methods.
- Prepare a written contingency plan between local agencies that outlines responsibilities for major spills from tanker trucks.
- Drainage from stored materials should be treated to remove sediments.
- Salt/pickled sand storage areas should be covered.
- Drainage from the entire site should be directed to a stormwater management facility to remove sediment and oils and grease.

Municipal works yard material storage

Municipal vehicle maintenance and repair

BENEFITS

- **General:** A preventative program will reduce discharge of contaminants, improve public image and reduce liability (due diligence). Active stormwater management controls further guarantee benefits.
- **Pollutants Reduced:** Heavy Metals, Toxic Materials, Oil and Grease, Suspended Solids.
- **Beneficial Uses Improved:** Contaminated sediments, aesthetics, and aquatic life.

REQUIREMENTS

- **Cost Implications:** Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be very expensive.
- **Program Support:** This BMP has no significant administrative or staffing requirements. Training is crucial to reduce the frequency, severity and effects of leaks and spills.

FACTSHEET

Municipal Yard Operation

- **Equipment:** No major equipment needed.
- **Policy/By-laws:** Waste generators, including municipalities, must be registered with the Ministry of the Environment under Ontario Regulations 347, for each location that would store hazardous waste produced on the site. Each generator must also register each subject waste that is produced at the site. This information is required in order to properly dispose of each waste.
- Technical Standards and Safety Act & Codes.
- Environmental Protection Act, Part X – Spills Notification, e.g. Spills Action Centre (SAC).

PUBLIC EDUCATION/ INVOLVEMENT

- Inform the public of the program – be a good corporate example for the private sector.

LINKAGES

- **Program:** Pollution Prevention and Control. Environmental Management System.
- **Related practices:** Municipal housekeeping practices.

LIMITATIONS

- Space and time limitations for vehicle repairs may preclude all work being conducted indoors.
- Identification of engine leaks may require some use of solvents.
- Dry floor cleaning methods may not be sufficient for some spills. Special clean-up methods may be required depending on contaminant leaked or spilled.
- Site limitations may make it difficult to install a stormwater management pond.

REFERENCES

California Storm Water Best Management Practice Handbooks; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Municipal & Residential Housekeeping MO8

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

The promotion of efficient and safe housekeeping practices (storage, use, cleanup and disposal) when handling potentially harmful materials such as fertilizers, pesticides, cleaning solutions, paint products, automotive products and swimming pool chemicals. Good housekeeping practices include storing hazardous products securely, safely and in original containers; reading and following product instructions; working in well-ventilated areas; and properly disposing of products.

APPROACH

- Pattern a new program after the many established programs from municipalities across the country. Integrate this best management practice (BMP) as much as possible with existing programs in the municipality.
- This measure involves three key audiences: municipal employees, the general public and small businesses.
- Implement this measure in conjunction with the safer alternative products measure.

BENEFITS

- **General:** Prevention programs reduce spills and decrease liability (due diligence).
- **Pollutants Reduced:** Sediment, Nutrients, Toxic Materials, Oxygen Demanding Substances, Oil and Grease.
- **Beneficial Uses Improved:** Potential spills are reduced along with resulting damage to aquatic life.

REQUIREMENTS

- **Cost Implications:** The primary cost for good, housekeeping practices is for staff time.
- **Program Support:** Staff is needed to train municipal employees and coordinate public education efforts. Municipal employees who handle potentially harmful materials should be trained in good housekeeping practices. Personnel who use pesticides must be trained in their use. Commercial pesticide application within the Province of Ontario requires certification.

Safe storage of flammable materials

- **Equipment:** There are no major equipment requirements for this BMP.
- **Policy/By-laws:** There are no additional regulatory requirements that apply to this BMP. Existing regulations require municipalities to properly store, use and dispose of hazardous materials and waste. This source control also focuses on materials and waste that may not be hazardous in a regulatory sense but deleterious to water quality and organisms. Housekeeping practices of the general public are addressed through education rather than regulation.

PUBLIC EDUCATION/ INVOLVEMENT

- Public awareness is a key to this BMP. The continued use or switch to good housekeeping practices is a behaviour and behaviour is based upon awareness.
- Public education programs should be promoted which provide information on such items as: storm water pollution and beneficial effects of proper disposal on water quality; reading product labels; safer alternative products; safe storage, handling and disposal of hazardous products; list of local agencies and emergency phone numbers. The following are examples of topics to be covered under a public education program.

FACTSHEET

Municipal and Residential Housekeeping

- Do not dispose of household hazardous waste:
  - in trash;
  - down storm drains or into creeks;
  - down sink or toilet;
  - onto the ground; or
  - by burning.
- Dispose hazardous wastes at household hazardous waste collection events or facilities.
- Written materials on safe use and disposal of hazardous materials should be included in public information packages.

LINKAGES

- **Program:** Pollution Prevention and Control. Environmental Management System.
- **Related practices:** Prevention and detection of illicit connections to storm sewers.

LIMITATIONS

There are no major limitations to this best management practice.

REFERENCES

California Storm Water Best Management Practice Handbooks; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Tank Spill Prevention and Control

M09

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Prevention or reduction of discharge of pollutants to stormwater from aboveground storage tanks can be done by installing safeguards against accidental releases, installing secondary containment, conducting regular inspections and training employees in standard operating procedures and spill cleanup techniques.

APPROACH

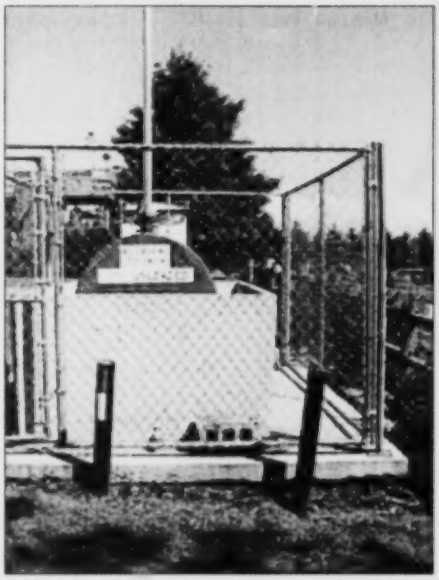
- Integrate efforts with existing, aboveground petroleum storage tank programs through the local fire and health departments, and with the local emergency response plan coordinated by the municipality.
- Use engineering safeguards to reduce the chance for spills.
- Perform regular maintenance.
- Keep ample supplies of spill cleanup materials at all facilities.
- Update spill cleanup materials as changes occur in the types of chemicals stored on site.

BENEFITS

- **General:** Public health and safety, workplace safety.
- **Pollutants Reduced:** Toxic Materials, Oil and Grease.
- **Beneficial Uses Improved:** Contaminated sediments, aquatic life, and aesthetics.

REQUIREMENTS

- **Cost Implications:** Costs will vary depending on the size of the facility and the necessary controls.
- **Program Support:** This best management practice (BMP) has no significant administrative or staffing requirements. Well-trained employees can reduce human errors that lead to accidental releases or spills.



Containment dike to contain accidental spills from above ground tanks

- **Equipment:** Containment systems (either purchased or custom manufactured).
- **Policy/By-laws:** Ministry of the Environment Environmental Protection Act; CCME Code of Practice; National Fire Code; Technical Standards and Safety Act & Codes.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Illicit Connection to Storm Sewer **M010**

Prevention and Detection

FACTSHEET

Type of Measure
FLOW REDUCTION
SOURCE CONTROL
DRAINAGE SYSTEM CONTROL
Program Element
RESIDENTIAL
COMMERCIAL ACTIVITY
INDUSTRIAL ACTIVITY
MUNICIPAL ACTIVITY

DESCRIPTION

Preventing unwarranted physical connections to the storm drain system from sanitary sewers and floor drains through regulation, regular inspection, testing and education can remove a significant source of stormwater pollution.

APPROACH

The following steps are components of this best management practice (BMP):

- Ensure that existing provincial municipal building and plumbing codes prohibit physical connection of non-stormwater discharges to the storm drain system.
- Require visual inspection of new developments or redevelopments during development phase.
- Develop documentation and record keeping protocols to track inspections and catalogue the storm drain system.
- Use techniques such as zinc chloride smoke testing, fluorometric dye testing and television camera inspection to verify physical connections.
- Carry out routine monitoring of storm sewers to detect contamination from sanitary sewage, and follow up with location and disconnection of illicit connections.

BENEFITS

- **General:** An active program will reduce pollution and reduce liability (shows due diligence) for pollution from storm sewers.
- **Pollutants Reduced:** Nutrients, Oxygen Demanding Substances, Bacteria.
- **Beneficial Uses Improved:** Swimming, aesthetics, contaminated sediments, aquatic life.

REQUIREMENTS

- **Cost Implications:** Zinc chloride smoke testing, fluorometric dye testing and television camera inspection can be costly. Labour and equipment cost for verification of plumbing connections is also a factor.
- **Program Support:** Building and plumbing inspectors must verify and document

Regular inspection and testing of storm sewers can prevent unwarranted pollution

inappropriate discharges into the storm drain system. Additional follow-up time is required to verify that corrective measures have been carried out.

- **Equipment:**
  - Personal protective equipment (hard hats, boots, plastic gloves, coveralls);
  - Sampling containers and storm water test kits;
  - Self-contained breathing apparatus;
  - Oxygen/combustible and hydrogen sulfide gas meters;
  - Closed circuit television (CCTV) pipeline camera;
  - Smoke and dye testing equipment.
- **Policy/By-laws:** Ontario Plumbing and Building Codes; Municipal Sewer Use by-laws.

PUBLIC EDUCATION/ INVOLVEMENT

- Consider a community awareness program (using various media), targeting appropriate audiences (homeowners, businesses and contractors) to warn against improper connections to the storm drain system and encourage public reporting of illegal connections through a community hotline telephone number. Notify community and local fire departments before testing with zinc chloride smoke testing and fluorometric dye testing in targeted areas.

FACTSHEET

Illicit Connection to Storm Sewer

LINKAGES

- **Program:** Sewer system operations.
- **Related practices:** Downspout disconnection by-law, sewer rehabilitation, and leaking sanitary sewer control.

LIMITATIONS

The following limitations may be applicable:

- Proper connections may be verified on date of inspection but could be altered afterwards by illicit connections.
- The cost for inspection equipment can be high.
- Improper physical connections to the storm drain system can occur in a number of ways, such as the overflow of cross-connections from sanitary sewers and floor drains from businesses such as auto shops and restaurants.

APPLICATION EXPERIENCE

- During dry weather surveys of outfalls to the Don River in Toronto, approximately 16% were exceeding by-law limits for bacteria, 31% for suspended solids, and 25% for iron. In follow-up surveys in the storm sewer system to locate sources of contamination, mostly cross connections of sanitary services to storm sewers, were recommended.
- St. Catharines Dry Weather Survey, 1986 to 2001 (Toth, 1993). This annual program involves sewer flow monitoring in dry weather, and sewer connectivity investigations. Remedial works can be in order of $1,000s, or $50,000 plus. The investigation work is time consuming and labour intensive.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.
- *Investigation of Inappropriate Pollutant Entries into Storm Drainage Systems – A Users Guide*, EPA600/R-92/238, January, 1993.
- Canviro Consultants, 1987, Don River Dry Weather Survey, *TAWMS Technical Report* #11, MOE.
- Toth, C., 1993. *Realities of Pollution Control Planning and Implementation: St. Catharines Strategy Proceedings, Stormwater Management and Combined Sewer Control Technology Transfer Conference*, Toronto 1993, Environment Canada.

Leaking Sanitary Sewer Control

M011

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Control procedures should be implemented for identifying, repairing and remediating infiltration, inflow and wet weather overflows from sanitary sewers to the storm drain conveyance system. Procedures include field screening, follow-up testing and compliance investigation.

APPROACH

The approaches listed below may be useful for sanitary sewer control:

- Identify dry weather infiltration and inflow first. Sewer flow monitoring is needed. Wet weather overflow connections are difficult to locate.
- Locate wet weather overflows and leaking sanitary sewers using conventional source identification techniques, including:
  - Field screening program (including field analytical testing);
  - Fluorometric dye testing;
  - Zinc chloride smoke testing;
  - Closed circuit television (CCTV) video camera inspection;
  - Nessler reagent test kits for ammonia detection; and
  - Citizens' hot line for reporting of wet weather sanitary overflows.

BENEFITS

- **General:** An active program reduces pollution and shows due diligence.
- **Pollutants Reduced:** Nutrients, Oxygen Demanding Substances, Bacteria.
- **Beneficial Uses Improved:** Swimming, aesthetics, contaminated sediments.

REQUIREMENTS

- **Cost Implications:** Cost implications include the following:
  - There may be program costs for procuring necessary equipment and training.
  - Departmental cooperation is recommended for sharing or borrowing staff resources and equipment from municipal wastewater treatment departments. Infiltration, inflow and wet weather overflows from sanitary sewers can be labour and equipment intensive to locate.

Closed circuit television (CCTV) used to inspect sewers

- **Program Support:**
  - Two-person teams are needed to perform field screening and associated sampling.
  - Larger teams are required for fluorometric dye testing, zinc chloride smoke testing, CCTV inspection and physical inspection with confined space entry.
  - Program coordination is required for handling emergencies and record keeping.
- **Equipment:** The following equipment may be needed:
  - Personal protective equipment (such as hard-hats, boots, plastic gloves and coveralls);
  - Self-contained breathing apparatus;
  - Oxygen/toxic/combustible gas detection meters;
  - Sampling containers/equipment;
  - Stormwater test kits;
  - Zinc chloride smoke and dispersal fans;

FACTSHEET

Leaking Sanitary Sewer Control

Overflowing sewer manhole

- Flurometric dye and fluorometer (optional);
- Closed circuit television (CCTV) with videocassette recorder;
- Vehicle(s) and communication equipment.

- **Policy/By-laws:** Sewer use by-law.

PUBLIC EDUCATION/ INVOLVEMENT

- Consider a public awareness program through local media to identify the problem of sanitary infiltration and wet weather overflows to the storm sewer system.
- Establish a community response hotline for reporting observed sanitary leaks (in dry weather) and wet weather sanitary overflows to the storm sewer system.
- Public notification, including notifying the local fire department is required for fluorometric dye or zinc chloride smoke testing in targeted areas.

LINKAGES

- **Program:** Sewer system operation.
- **Related practices:** Illicit connection to storm sewers. Inflow and infiltration control.

LIMITATIONS

- Private property access rights needed to perform field screening/testing along storm drain right-of-ways.
- Some local ordinances require suspicion of illicit connection for guaranteed right of entry to conduct verification testing.

REFERENCES

- California Storm Water Best Management Practice Handbooks; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Local Drainage and Inlets

Local drainage and inlet measures and practices relate to controls that are applied to urban drainage systems including both surface drainage and local sewer systems. These are generally not "at-source" measures, but relate to the control of how stormwater is conveyed in the upper or early stages of the sewer system, often before entry into the piped storm or combined sewer system. The measures outlined include:

LD1 Grassed Waterways

LD2 Inflow and Infiltration Control (I/I)

LD3 Detention and Infiltration Device Maintenance

LD4 Natural Drainage Elements

LD5 Inlet Controls – Flow Reducers

Grassed Waterways

LD1

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Use of grassed waterways for stormwater conveyance, particularly for overland flow systems in urban development areas to replace conventional storm sewers. This can include roadside ditches as well as swales between lots, and through open space areas. Generally refers to headwater systems that only convey flows on an intermittent basis.

APPROACH

Design a conveyance system that provides for grassed waterways where possible. Can have a grassed waterway parallel to a storm sewer (i.e. back of lot drainage system) or as a receiving channel for storm sewers.

BENEFITS

- **General:** Provides for slower conveyance of stormwater and storage to reduce peaks. Provides an opportunity for infiltration to reduce runoff volumes. Vegetation filters pollutants from runoffs. Provides habitat for wildlife and food source for downstream aquatic habitat.
- **Pollutants Reduced:** Sediment, nutrients, heavy metals, toxic materials, oxygen demanding substances, and bacteria.
- **Beneficial Uses Improved:** Aesthetics, downstream water quality, and reduced potential for instream erosion.
- **Performance:** Drainage areas up to 2 ha can be serviced by grassed swales (at 35% imperviousness), assuming a channel slope of 0.5%, 0.75m bottom width, and maximum allowable flow of 0.15 m3/s and maximum allowable velocity of 0.5 m/s. Check dams can be added at intervals to enhance infiltration and sedimentation. If space is available, the addition of a vegetated filter strip can further enhance infiltration and sediment removal.

REQUIREMENTS

- **Cost Implications:**
  - Additional land for conveyance system
  - Cost of channel $36.00/m

Grassed swales reduce peak flow and trap sediments and nutrients

- **Program Support:**
  - Maintenance of vegetation
  - Removal of sediment may be necessary
  - Removal of litter and posting of signs for litter control
- **Equipment:**
  - Parkland maintenance equipment
  - Soil excavation and removal
- **Policy/By-laws:**
  - Greenspace management
  - Litter control

PUBLIC EDUCATION/ INVOLVEMENT

- Education programs will generally be necessary to gain acceptance of roadside ditches and grassed swales between lots. Should be directed at the environmental benefits provided.
- Proper treatment of greenways.
- Litter control.

LINKAGES

- **Program:** Flow control, pollution control.
- **Related practices:** Infiltration, natural drainage systems.

LIMITATIONS

- Require excess depth to provide outlet for storm sewers (if storm sewers are upstream of the application).

FACTSHEET

Grassed Waterways

- Drainage area limitations to prevent excess flow volumes and velocity that would erode the channel.

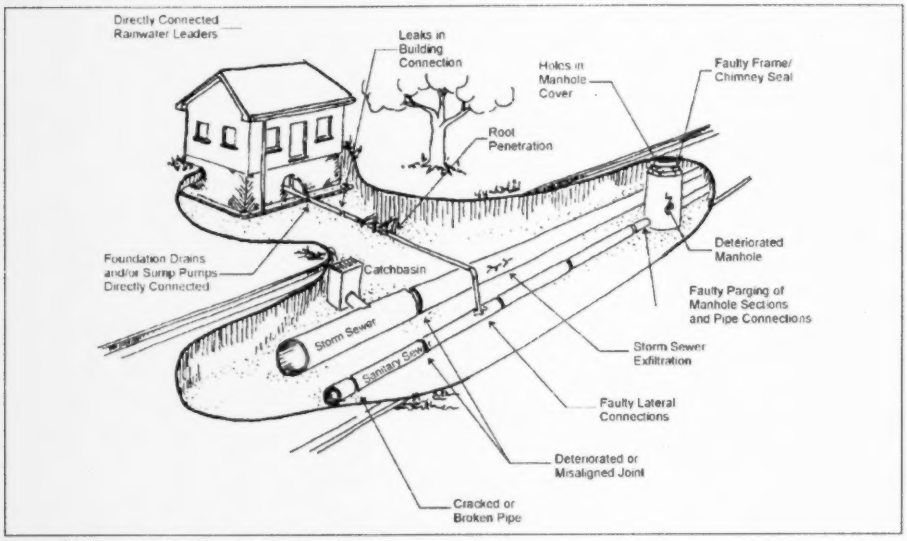
REFERENCES

- J.F. Sabournin and Associates, *Evaluation of Roadside Ditches and Other Related Stormwater Management Practices*, April 1997, published by Toronto Region Conservation Authority.
- MOE, 1994, *Stormwater Management Practices Planning and Design Manual*, and updates.

Inflow and Infiltration Control

LD2

FACTSHEET



Typical inflow and infiltration problems

DESCRIPTION

Control of extraneous flow to sanitary sewers (and combined) is closely related to sewer rehabilitation. The types of inflow and infiltration (I/I) are defined as follows:

- Inflow is the water (other than wastewater from sanitary sources) entering the sanitary or combined sewer system from the surface through downspouts, catchbasins maintenance hole covers, and cross connections to storm sewers.
- Infiltration is the water entering the sanitary or combined sewer system from the ground through defects in the piping system (broken pipes, leaking joints) or through foundation drains. Infiltration may occur in dry weather from an elevated ground water table, or may increase following rain events (rainfall induced infiltration).

The effects of the I/I flows are to:

- cause sanitary sewer overflows, increase combined sewer overflows, and treatment plant bypasses;
- use up capacity in sewers, pumping stations and treatment plants, requiring earlier expansions to accommodate growth;
- increase pumping and treatment costs; and
- increase load of contaminants to the environment.

APPROACH

The approach to reducing flows depends on the source, which can be determined by an investigation of the sewer system. The type of sewer and source of the inflow or infiltration affect the control approach and cost significantly. In particular, clean rooftop drainage from downspouts does not need treatment and is a good candidate for draining to the surface or to an infiltration measure.

The methods of investigation include:

- flow measurement at various locations in the sewer system to identify areas of high I/I and with examination of the flow response to rain, give an indication of the sources;
- visual inspection of maintenance hole lids and structures for leaks, visual inspection of downspout connections;
- television inspection of sewers for cross connections, broken pipes and leaky joints;
- smoke studies to indicate downspouts connected to sanitary sewers and dye studies to locate cross connections.

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

FACTSHEET

Inflow and Infiltration Control

CONTROL OR REHABILITATION CAN CONSIST OF THE FOLLOWING:

Problem	Method	Implications
Downspout connected to sanitary/combined sewer	Downspout disconnection program (see separate fact sheet).	See separate fact sheet.
Foundation drain connected to sanitary/ combined sewer	Install sump pumps and connect to surface or storm sewer. Redirect connection to storm sewer.	Relatively high cost. Difficulty examining private property connections. Many connections made legally when constructed.
Leaking joints in sewer or with private connection	Sewer rehabilitation, including reconstruction of sewer, or relining of sewer.	Sewer reconstruction is high cost and disruptive to traffic and the surrounding uses. This may be an opportunity to install alternate drainage features such as infiltration devices in the road right of way.
Broken sewer	Relining, spot reconstruction, major reconstruction if extensive and linked to other problems.	
Maintenance hole leaks	Spot repair. Replace maintenance hole covers.	Low cost.
Connection of surface drains to combined sewer system	Reroute to storm drains. Source flow reductions or infiltration measures at the inlet.	Moderate costs depending on the area drained and opportunities presented by the land use and density.

BENEFITS

- **General:** Reduced costs for sewage treatment and pumping, increased capacity in sewer system and sewage treatment can defer capital expenses for expansion to accommodate new growth.
- **Pollutants Reduced:** Pollutants in combined sewer overflows reduced include: sediment, nutrients, heavy metals, toxic materials, floatable materials, oxygen demanding substances, oil and grease, and bacteria.
- **Beneficial Uses Improved:** Swimming, aesthetics, and aquatic life.

REQUIREMENTS

- **Cost Implications:** Sewer investigation studies (in Ontario often called infrastructure needs studies) may require engineering consulting firms or specialized service companies to investigate and analyse the system. Capital costs for rehabilitation can be high with benefits largely in reduced operation costs. An economic analysis should be carried out to establish locations and measures that are cost effective. If capital costs to expand sewage treatment or control overflows are expected, then I/I control programs can be more attractive, i.e. economically justified.
- **Program Support:** Ongoing inspection services in the municipality can identify many of the problems and carry out repairs as part of the ongoing maintenance program. A program to support disconnection of downspouts and foundation drain connections may be needed, to enforce legal requirements to disconnect, or to assist in voluntary disconnection measures.
- **Equipment:** Specialized equipment is needed for inspection. Different rehabilitation measures may require specialized equipment for installation, e.g. sewer relining.
- **Policy/By-laws:** By-laws specific to downspout and foundation connections are usually in-place. Specific programs or by-laws may be required for connections made prior to the by-law enactment.

FACTSHEET

Inflow and Infiltration Control

PUBLIC EDUCATION/ INVOLVEMENT

- Programs to encourage voluntary disconnection of downspouts and foundation drain connections should be put in place, in conjunction with technical support.

LINKAGES

- **Program:** Flow reduction program, downspout disconnection program, sewer use by-law, and water conservation program.

APPLICATION EXPERIENCE

- In San Antonio, Texas, a maintenance hole rehabilitation program was carried out over two years for 30,000 maintenance holes. Rehabilitation costs, including investigative studies, design and construction totaled $11.6 million ($US in 1991). Dry weather I/I was reduced 47% and wet weather I/I was reduced 14%. The 20-year total cost savings for the flow eliminated was estimated at $104 million for transportation (sewers and pumping) and treatment (Infiltration/Inflow Performance Evaluation, San Antonio, Texas, WEF Conference Proceedings, 1992).

REFERENCES

- *ASCE Manual of Practice No. 62* and *WEF Manual of Practice FD-6*, 1983.Existing Sewer Evaluation & Rehabilitation.
- EPA/625/6-91/030, 1991. Handbook-Sewer System Infrastructure Analysis and Rehabilitation.
- MOE, 1994, *Stormwater Management Practices Planning and Design Manual*, and updates.

Detention and Infiltration Device Maintenance LD3

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Detention ponds and infiltration devices collect litter and sediment deposits. Proper maintenance and silt removal is required on both a routine and corrective basis to promote effective pollutant removal efficiencies.

APPROACH

These approaches may be beneficial for detention and infiltration device maintenance best management practice (BMP):

- Remove silt after sufficient accumulation.
- Periodically clean accumulated sediment and silt from pretreatment inlets.
- Infiltration device silt removal should occur when the infiltration rate drops below 13 mm (0.5 in.) per hour.
- Removal of accumulated paper, trash and debris should occur at least every 6 months or as needed to prevent clogging of control devices.
- Mow the slopes periodically and check for clogging and erosion.
- Corrective maintenance may require more frequent attention.

BENEFITS

- **General:** Stormwater retention/recharge basins dispose of surface water and recharge groundwater aquifers. Monitoring has confirmed that a variety of organic and inorganic contaminants generated in the catchments are removed by sorption within the top 4 cm of sediment in the recharge basin, making these contaminants available for removal and disposal through routine maintenance. Monitoring results also established that contaminants have not degraded groundwater quality beneath the basins.
- **Pollutants Reduced:** Sediment, heavy metals, oxygen demanding substances, and bacteria.
- **Beneficial Uses Improved:** Aesthetics, contaminated sediments, and aquatic life.
- **Performance:** Removal of sediments improves performance. Infiltration devices can be completely clogged, with substantial improvements in efficiency after maintenance. MOE (1994 and updates) suggests that sediments be removed when suspended solids removal efficiency drops by 5%.

Maintenance and silt removal to promote effective pollutant removal efficiencies

REQUIREMENTS

- **Cost Implications:** Frequent sediment removal is labour intensive and costly. Transport and disposal costs for waste material will vary proportionately with the volume of material. Disposal costs can be high if sediments have high levels of toxins.
- **Program Support:** Staff complement will vary depending upon the size of the program. A staff team is required to respond to corrective maintenance measures. Training of staff in appropriate excavation and maintenance procedures and proper disposal methods is required.
- **Equipment:** Equipment considerations include vehicles, dump trucks, bulldozers, backhoes, excavators, mowers, weed trimmers, sickles, shovels, rakes and personal protective equipment (goggles, dust masks, coveralls, boots and gloves).
- **Policy/By-laws:** Certificates of Approval for stormwater facilities issued under the Ontario Water Resources Act often have standard conditions requiring maintenance of the facility and specifically for removal of sediment. Sediment disposal is covered by guidelines (MOE 1996). Municipalities often require the developer to remove sediment from facilities before assuming ownership.

FACTSHEET

Detention and Infiltration Device

PUBLIC EDUCATION/ INVOLVEMENT

- It may be useful to create a public education campaign to explain the function of wet and dry detention ponds and infiltration devices and their operational requirements for proper effectiveness. Also, encourage the public to report facilities needing maintenance – where possible, publish a municipal contact and phone number.

LINKAGES

- **Program:** Stormwater management facility maintenance. Sewer system maintenance.
- **Related practices:** Erosion control.

LIMITATIONS

- Dredging sediments in wet detention ponds produces slurried waste that often exceeds the limits for acceptability used by many landfills.

APPLICATION EXPERIENCE

- Greenland (1999) presents several case studies.

REFERENCES

- Greenland International Consulting Inc, August 1999, *Stormwater Management Facility Sediment Maintenance Guide*, published by Toronto Region Conservation Authority.
- Ministry of the Environment, June, 1996, *Guideline for Use at Contaminated Sites in Ontario.*
- Ministry of the Environment, 1994 and updates. *Stormwater Management Practices Planning and Design Manual.*

Natural Drainage Elements

LD4

FACTSHEET

Type of Measure
FLOW REDUCTION
SOURCE CONTROL
DRAINAGE SYSTEM CONTROL
Program Element
RESIDENTIAL
COMMERCIAL ACTIVITY
INDUSTRIAL ACTIVITY
MUNICIPAL ACTIVITY

DESCRIPTION

The use of natural drainage elements in the design and implementation of conveyance facilities. This can include the preservation of existing streams particularly "headwater" streams (i.e. located near the top of a watershed) and channels when developing lands or the construction of new "natural" watercourses. Vegetation is used to enhance the uptake of nutrients and pollutants and to provide aquatic and terrestrial habitat.

Grassed swales will provide similar benefits, however, more effective vegetation including shrubs, trees and wetland plants (in appropriate areas) should be applied where possible.

APPROACH

The development layout, lot sizes and conveyance system will influence the feasibility and/or application of this approach.

Specific Approach:

- The width of easement required is dependent on the design of the channel system.
- Channel design is dependent upon:
  - conveyance needs (capacity);
  - outlet requirements (depth);
  - channel requirements for stability (i.e. side slopes for stability, meander belt width for natural streams).
- Stream setbacks (buffer widths) are dependent upon protection requirements generally:
  - coldwater streams – 30 m;
  - warmwater and degraded systems – 15 m.
- Riparian vegetation along streams will be required to mitigate impact to water temperature, filtration for water quality and wildlife habitat linkages wherever possible.

BENEFITS

- **General:**
  - Provision of natural drainage will reduce flows.
  - Reduced pollutant loadings to streams.
- **Pollutants Reduced:** Sediment, nutrients, toxic compounds, pesticides, bacteria and temperature.

Vegetation is used to enhance the uptake of nutrients and pollutants

- **Beneficial Uses Improved:** Aesthetics, and aquatic life.
- **Performance:**
  - Vegetative buffers can provide over 75% removal of sediment in sheet runoff to streams.
  - Stream temperature can be reduced to coldwater levels if ground water inflow occurs. Stream temperature increases will not occur with effective stream cover (high canopy bushes or trees).

REQUIREMENTS

- **Cost Implications:**
  - Costs for operation and maintenance.
  - Research has indicated that life cycle costs are less than those for open systems with hard linings. Patterson (1999) indicates a threefold saving for using natural channel designs over large concrete channels based on several case studies.
- **Program Support:** Maintenance, may require some trimming and removal of dead falls, depending upon application.
- **Equipment:** Landscaping equipment.
- **Policy/By-laws:**
  - Regulations for open drainage systems;
  - Easements, fill lines;
  - Protection of buffer systems, avoiding intrusion;
  - Parks, pathway design and application.

FACTSHEET

Natural Drainage Elements

PUBLIC EDUCATION/ INVOLVEMENT

- Many stream rehabilitation/enhancement and clean-up projects carried out with community involvement can provide a significant cost reduction, and instill community ownership and commitment to protecting and maintaining the natural system.

LINKAGES

- **Program:** Stream rehabilitation, channel erosion control.
- **Related practices:** Grassed waterways, and bioengineering.

LIMITATIONS

- Requiries additional land for stream corridor system and buffers.
- Policies are required for protection of stream corridor in headwater systems beyond most current floodplain and natural environment policies.

APPLICATION EXPERIENCE

- The approach is encouraged in a number of planning jurisdictions and Ontario Conservation Authorities, (particularly Toronto and Region Conservation Authority, Credit Valley Conservation, Grand River Conservation Authority). Extensive case studies are given in Patterson (1999).

REFERENCES

- Ministry of Natural Resources, June 1994, *Natural Channel Guidelines for Design and Management.*
- Timothy S. Patterson, January, 1999, *Comparison of Soil Bioengineering and Hard Structures for Riverine and shoreline Erosion Control in Ontario – Costs and Effectiveness*, Environment Canada.
- The Federal Interagency Stream Restoration working Group 1998, *Restoration, Principles Processes and Practices.*
- MOE, 1994, *Stormwater Management Practices Planning and Design Manual*, and updates.

Inlet Controls – Flow Reducers

LD5

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

The provision of inlet control devices to limit the flow of stormwater to storm or combined sewers. Can be used with or without storage at the control device. Excess water will be stored or continue to flow overland.

APPROACH

The facility can be used to limit the flow of stormwater when the capacity of the downstream facility is limited (or to avoid overflow of a combined system). The feasibility will depend upon the potential for flooding when flows are limited at the inlet.

The sizing of an inlet control will depend upon:

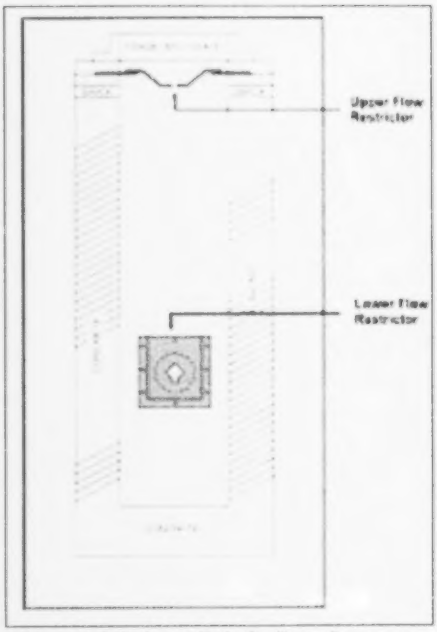
- design criteria for conveyance (major overland and minor piped system),
- the available downstream capacity,
- available storage or major overland conveyance system to carry the excess flows,
- types of inlet control including: orifice plates and vortex valves,
- acceptability of street ponding for longer periods during and after storm events.

BENEFITS

- **General:** Reduces flows in the sewer system (combined or otherwise) and reduces the potential for overflow or treatment requirements, and prevents flooding of properties connected to sewers.
- **Pollutants Reduced:** Pollutants associated with combined sewer overflows (CSOs), no impact if flow reduced to storm sewers.
- **Beneficial Uses Improved:** Reduced CSOs, improved swimming, bacteria, and aesthetics.
- **Performance:** Quantified overflow reduction. Vortex valves, while more expensive, are less likely to clog, since the cross sectional flow area is 4 to 6 times larger than an equivalent orifice.

REQUIREMENTS

- **Cost Implications:** Installation cost; maintenance if blocked.
- **Program Support:** Maintenance staff.



Inlet control device to limit the flow of stormwater to storm or combined sewers

- **Equipment:** Sewer maintenance equipment.
- **Policy/By-laws:** Level of ponding on street systems needs to be considered, and engineering standards.

PUBLIC EDUCATION/ INVOLVEMENT

This measure may result in surface ponding. Public information may be necessary to educate.

LINKAGES

- **Program:** Flow reduction. Flood Prevention.
- **Related practices:** Downspout disconnection.

LIMITATIONS

- Limited to areas with available storage or overland flow path. Can result in surface ponding.

APPLICATION EXPERIENCE

- These are in limited use in the Toronto area.

FACTSHEET

Inlet Controls – Flow Reducers

REFERENCES

- W.C. Pisano. *Inlet Control Concepts on Catchbasins – U.S. Experience in Urban Stormwater Quality Enhancement*, ed. H.C. Iowa, ASCE, 1989.

PART III - CASE STUDIES

Part III outlines sample watershed studies, municipally based pollution prevention studies, and flow reduction programs. These case studies include a range of community sizes and resources, the approaches used to deal with pollution problems, and the effectiveness of the approaches.

- Centennial Creek Stormwater Retrofit Study;
- Emery Creek Environmental Association;
- City of Belleville Pollution Control Plan – Bay of Quinte Area of Concern;
- Community of Ancaster;
- City of St. Catharines;
- Regional Municipality of Waterloo;
- City of Hamilton;
- City of Toronto; and
- Watershed Infrastructure Ecology Program (WIEP)-Toronto

CENTENNIAL CREEK STORMWATER RETROFIT STUDY

Centennial Creek subwatershed (see **Figure 1.0**):

- Contains one of three major watercourses in Scarborough;
- Drains approximately 740 hectares outletting into Highland Creek just north of Lake Ontario;
- is located in Toronto RAP with the objective to improve near-shore water quality in Lake Ontario;
- has a fully urbanized watershed, predominantly residential;
- is in a state where urbanization has altered the hydrologic cycle and natural ecosystem, however some environmental amenities remain (limited wetlands, relatively continuous stream corridor);
- has no SWM quality facilities;
- is served by separate storm sewers.

What are the Issues and Goals for the Subwatershed?

The objective of this urban retrofit study was to develop a remediation plan for the subwatershed to meet the goal of improved water quality at the outlet of Centennial Creek and environmental conditions along the stream corridor. The stormwater retrofit study was carried out in parallel with the subwatershed study, carried out by independent consultants.

The stormwater quality management goals adopted for the retrofit study were:

A. Ecosystem goals

- Rehabilitate and enhance the existing hydrologic cycle; and
- Rehabilitate and improve the existing runoff quality.

B. Economic goals

- Integrate stormwater quality management strategy with municipal capital works and operation programs; and
- Minimize the cost of stormwater quality management in urbanized areas.

The ecosystem and economic goals were then defined by the following objectives:

1. Reduction of the existing annual runoff volume up to 25%;
2. Reduction of the existing annual total suspended solids loading up to 50%; and
3. Application of proven and cost-effective retrofit stormwater management practices (RSWMPs).

What approach was selected?

The management practices selected included a blend of at-source, conveyance and end-of-pipe controls (i.e., SWM ponds). Controls were to be selected in a hierarchy, with source controls preferred over conveyance controls which in turn were favoured over end-of-pipe controls. This is common to all watershed strategies in that a blend of measures is necessary to provide the most cost-effective approach.

The measures selected in this case are listed as follows:

- Downspout disconnection
- Oil/grit separators
- Stormwater exfiltration systems
- Stormwater quantity pond retrofit for quality control
- Stormwater quality ponds

How were the measures applied?

The facilities were evaluated for effectiveness in water quality protection and stormwater volume reduction. This was based on the removal/reduction efficiency of each measure and the consideration of a number of alternatives.

A combination of strategies can achieve most of the solids loading reduction target - 47% TSS reduction compared to the target of 50%, and all of the volumetric target of 25% flow volume reduction. The recommended strategy, which costs $2.1 million should be implemented as follows:

First 5 years

- Twenty percent of the feasible residential areas will have downspouts disconnected;
- The existing stormwater quantity pond will be retrofitted to provide water quality treatment; and
- A new stormwater quality pond will be constructed on City's property.

Over 15 years

- Fifty percent of the feasible residential areas will have downspouts disconnected;
- Twenty percent of the feasible commercial areas will be retrofitted with oil/grit separators; and
- Ten percent of the feasible roads/sewers in good condition now will be retrofitted with exfiltration systems as they deteriorate;

Over 25 years

- All the feasible residential areas will have downspouts disconnected;
- Thirty percent of the feasible commercial areas will be retrofitted with oil/grit separators; and

- Twenty percent of the feasible roads/sewers in good condition now will be retrofitted with exfiltration systems as they deteriorate;

Operational controls such as improved street sweeping practices and increased catchbasin sump maintenance and sewer flushing are also recommended to complement the strategy and make up the remaining 3% of the target objective of 50% total suspended solids load reduction.

Currently, most of the municipal capital and operating projects, such as road and sewer reconstruction or rehabilitation, in the Centennial Subwatershed are developed without consideration for stormwater quality improvement.

A sequence of actions the municipality may implement were identified:

1. A new stormwater quality pond on the city-owned site should be investigated. As land is redeveloped in the subwatershed, additional stormwater quality ponds should be considered as part of the redevelopment requirements.
2. As a capital project, the existing quantity pond should be retrofitted to provide a water quality treatment function.
3. All the feasible roads/sewers, which have been currently identified to be in poor condition, should be retrofitted with stormwater exfiltration systems as they are reconstructed or rehabilitated in the next 15 years. In the long term, as more roads/sewers need reconstruction, the stormwater exfiltration systems should be applied.
4. The feasible residential areas should have downspouts disconnected gradually. Ways to achieve a higher percent coverage for downspout disconnection should also be investigated, including combinations of subsidies, regulatory measures and application of additional technologies such as rain barrels and soak-away pits.
5. Where feasible all the roads in the commercial areas should be retrofitted with oil/grit separators as they are reconstructed or rehabilitated. Oil/grit separators can also be considered for retrofit in additional road systems, especially in high traffic areas where there is a higher potential of spills.
6. A methodology for measuring the benefits of the RSWMPs on receiving water should be developed.
7. The recommended stormwater quality management strategy should be reviewed and updated periodically as part of the Capital Budget Process.

References

Macviro Consultants Inc. 1995, *Centennial Creek Subwatershed Study Phase II* Report, City of Scarborough, Ontario, Canada.

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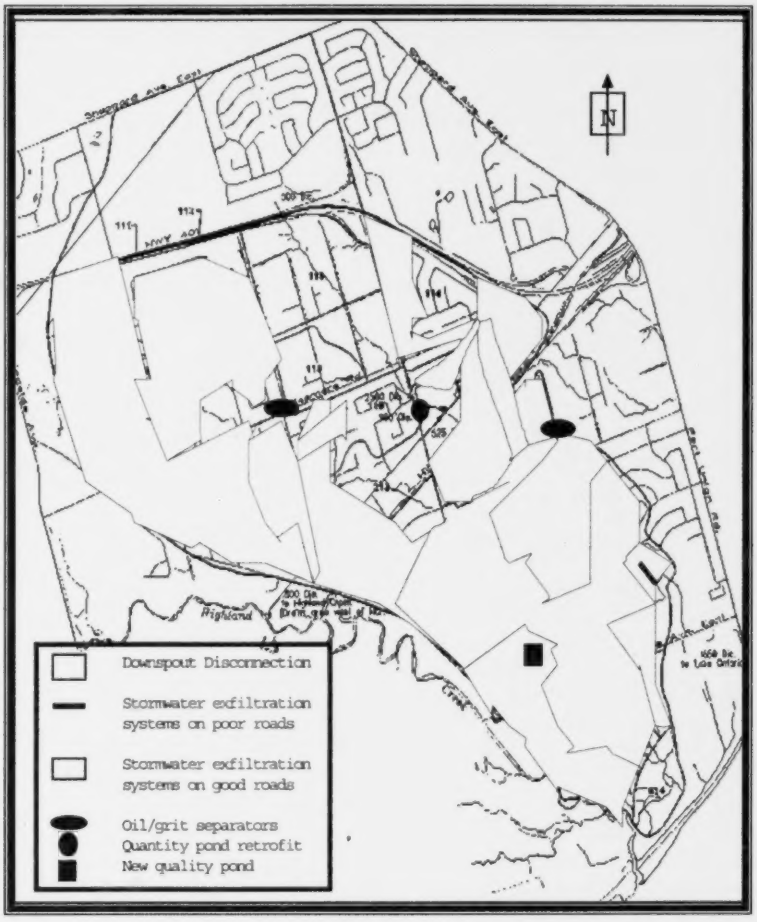

Figure 1.0: Centennial Creek Subwatershed

THE EMERY CREEK ENVIRONMENTAL ASSOCIATION

Emery Creek

- is a tributary to the Humber River draining a mixed industrial-commercial-residential area in Toronto, Ontario.
- was identified as the most polluted creek in the Humber watershed, and one of the worst polluted in Toronto, with high levels of contaminants and frequent chemical spills.
- has a drainage area of 700 hectares with over 3000 industrial and commercial businesses.

An industrial association was formed in 1993 to address watershed concerns.

What are the problems or issues?

Water quality problems in the Humber River were defined in the Toronto Area Watershed Management Strategy (TAWMS) study completed in 1986. Emery Creek was determined to be a primary source of fecal coliforms, heavy metals and phenolic compounds. Frequent spills were reported attributed to industrial and commercial sources. Most of the watercourse is either buried as sewers or converted to concrete channels.

The area has over 3000 industrial and commercial businesses with some residential land use. The businesses include almost every sector including food production, telecommunications, pharmaceuticals, automotive repair and waste management. Company sizes range from small "mom and pop" service businesses to 1000 employee manufacturers.

Enforcement activities of anti-pollution legislation and municipal by-laws was effective for large spills or obvious pollution offences, but could not prevent further spills from the many different companies, and did nothing to stop the polluted runoff from all the activities and sources.

How did they respond?

- The TAWMS study proposed that a stormwater management pond be constructed at the mouth of the creek, to treat all of the dry weather flow and capture spills, and treat part of the wet weather flow. This proposal is the subject of a Class Environmental Assessment study with Toronto as the proponent. EA approval was given in 1998. City Council has directed staff to form a neighbourhood liaison committee and proceed with detailed design.
- The Emery Creek Environmental Association was formed in 1993 to improve water quality in the creek through control at the source - in the industries and commercial businesses in the watershed.

Mission Statement

Emery Creek Environmental Association is a non-profit association of businesses and industries within the Emery Creek watershed. Our mission is to heighten the awareness of environmental responsibility for ourselves and our community, through voluntary participation in activities for pollution abatement. Our aim is that through voluntary participation, the health of this watershed, and consequently the Humber River and Lake Ontario, will improve to provide a sustainable benefit for this association, and all businesses and residents of our community.

Focus of Program

The program focuses on reducing the water and air pollution in the Emery Creek watershed through the promotion and facilitation of pollution prevention to local businesses. This includes identifying practices that lead to contamination of stormwater runoff from land drainage, and activities that could lead to spills into the storm system. It also includes reducing toxic discharges to sanitary systems to reduce contaminants in sewage treatment plant discharges and biosolids. While Emery Creek sewers are not combined, this focus in other systems would also reduce contamination in combined sewer overflows.

Education Program

The focus of the education outreach program has been to educate the business and residential community on the impact of pollution on the environment, and the pathways of pollution in an industrialized watershed, as well as foster and promote an environment where all parties can benefit from pollution prevention at the source.

Components of the outreach program include:

- A storm sewer marking program on business sites with the message "DO NOT DUMP — FLOWS TO CREEK"
- A newsletter with technical articles, pollution prevention tips, advice on ISO 14001, meeting notices, and success stories.
- Technical seminars on related environmental and pollution prevention topics. Often the free seminars cover issues that otherwise would cost several hundred dollars for participants to attend. This removed a major impediment for staff of small businesses to participate. Businesses are encouraged to suggest topics of particular relevance or interest to them, specifically within their environmental management practices.
- The Association supports a Resource Centre that businesses have access to in developing a pollution prevention plan.
- The Association helps companies in receiving recognition for accomplishments through government award programs.
- The Association facilitates networking between business, governments and non-governmental organizations for information sharing, pollution prevention planning and waste exchange.

Newsletter - Up the Creek

Recent issues have included articles on community recycling, energy efficiency, Bell Canada's returned material collection program, by-law enforcement issues, Ontario's pollution prevention program, transportation of dangerous goods information, and carpooling.

The newsletter is distributed to all industries in the watershed and serves as a major notice board and education vehicle for all businesses, including those that don't otherwise participate.

Challenges Addressed

- Raise awareness of the watershed environment - Many businesses do not know that they are part of a watershed with water quality concerns and an aquatic community to protect.
- Correct misconceptions - Storm sewers don't receive treatment and discharges to them can damage the watercourse.
- Identify key individuals in businesses - Change in an organization must be made by decision-makers.
- Be flexible in approach - Smaller businesses need more help and outreach since they generally do not have the time or resources to get involved.

Key Message

The association is selling a product. The "pollution prevention product" is not a cost item. Pollution prevention increases profits, improves production, and fosters a good corporate image while improving the environment.

Advantages of Approach

- The Association is voluntary and is not a government agency. Members are more likely to participate if they don't think they will be prosecuted for practices that may be exposed.
- The Association can respond to needs of the membership with direct support and advice, and tailor education seminars to direct requests and identified needs.
- The Association can take advantage of government support through grants and resources provided through pollution prevention programs.
- The Association membership often provides free advice from larger companies with professional environmental staff that offer consulting and training to smaller companies.

- As an environmental organization with a focus on businesses, the Association is in a unique position to bridge the gap between business and industry and to effectively liaise with both, as well as with the local residents and local organizations.

Guidance Document

A project to create a guidance document for ISO 14001 registration for small businesses has been developed with the participation of Emery Creek businesses, and support from the Ontario Ministry of the Environment, and coordinated by the Canadian Centre for Pollution Prevention. The document contains a model Environmental Management System, a model implementation plan, a checklist for the ISO 14001 standard, documentation of Emery Creek members' experiences, and a list of external resources.

References

This summary is based extensively on *"Up the Creek Without Pollution! Stormwater Pollution Prevention in the Emery Creek Watershed"* by Cheryl Gonsalves, Executive Director, Emery Creek Environmental Association, and Harold Leadlay, Environment Canada.

The Emery Creek Environmental Association may be contacted at 857 Fenmar Drive, Weston, Ontario, M9L 1C8. Tel: (416) 749-6373. E-mail: emery@interlog.com Website: www.interlog.com/~emery

CITY OF BELLEVILLE POLLUTION CONTROL PLAN – BAY OF QUINTE AREA OF CONCERN

The City of Belleville is:

- situated at the mouth of the Moira River, on the Bay of Quinte, Lake Ontario;
- is a primarily urban area in eastern Ontario;
- has a population of 46,000;
- lies within the jurisdiction of the Moira River Conservation Authority;
- is serviced by a separated sewer system;
- is responsible for stormwater management;
- can be contacted through the website http://www.city.belleville.on.ca

What are the problems?

Bacteriological contamination of surface waters in the Bay of Quinte has impaired beneficial use related to recreational activities in the Bay. The bacterial contamination is attributed primarily to stormwater runoff.

The Pollution Control Program for the City of Belleville quantified and located the sources of bacterial contamination under both dry and wet weather. Under dry weather, some of the storm outfalls are occasionally contaminated. However, the level of contamination is quite variable. For those sewers that were consistently contaminated, the source was identified and the problem tributary lines were isolated. Sanitary cross-connections and/or sewer leakages were suspected to be the cause of bacterial contamination in these lines.

During wet weather, bacterial contamination occurs in the receiving waters of the Moira River, increasing by approximately an order of magnitude compared to dry weather periods. These elevated bacterial concentrations lead to contamination of east Bayshore of the Bay of Quinte within the City of Belleville and a beach (Riverside Beach) within the Moira River.

The high levels of bacteria are attributed to wash-off of bacteria-laden sediment from urban surfaces, and suspension and transport of sediments that accumulate within the storm sewers during rain events. For the Riverside Beach, however, pigeons residing under the highway bridge upstream of this location are suspected to be the source of contamination since the contamination occurs during both dry and wet weather.

How did they respond?

A stormwater control plan was developed for the City of Belleville. Core components were:

(1) a source control program;

(2) a centralized stormwater retrofit treatment; and

(3) project-by-project stormwater control and treatment. Recommendations related to source control include street sweeping/catchbasin cleaning, identifying/eliminating sources of dry weather storm sewer contamination (sewer cross-connections), minimizing runoff from existing industrial and commercial properties, pet-litter control, public education, and minimizing runoff volumes as a principle to be applied to new development and to road/sewer reconstruction projects.

For (2), the recommendations consist of installation of end-of-pipe stormwater treatment to treat existing outfalls, where opportunities exist. For the project-by-project stormwater control and treatment, a stormwater control policy was recommended that sets out guidelines and procedures for reviewing the design of drainage systems for all new development and redevelopment projects, as well as road and sewer improvement projects. This policy is intended to ensure that, on each project, all opportunities are utilized to reduce stormwater volumes and stormwater contamination.

Disinfection, using ultraviolet irradiation, was recommended for consideration, only for those areas of high recreational use. Other recommended control measures included:

a) continued surveillance of the storm sewer system for bacterial sources,

b) following the recommended stormwater control policy,

c) construction of end-of-pipe stormwater quantity/quality ponds for specific outfalls, and

d) implementing a bird control program (at the Highway 401 bridge) for reducing/eliminating the pigeon population, and a public information program to discourage feeding of gulls and waterfowl.

Estimated cost of the control measures was $3.18 million.

THE COMMUNITY OF ANCASTER

The Community of Ancaster (former Town of Ancaster)

- is a primarily urban area of 174.55 km² in the New City of Hamilton (former Regional Municipality of Hamilton-Wentworth);
- lies partly within the jurisdiction of the Niagara Escarpment Commission;
- drains partly to the Grand River and partly to creeks of the drainage system of Hamilton Harbour;
- has a fast growing population of 23,403 (1996 figures);
- is responsible for stormwater management;
- is serviced by an 85% separated storm and sanitary sewer system and 15% septic systems alone;
- will provide information through Richard Tupholme, Director of Engineering, at the Town of Ancaster Offices, 300 Wilson Street East, Ancaster, Ontario. L9G 2B9.
  Phone: (905) 648-4405. Fax: (905) 648-3557.

What are the problems?

Water quality in Ancaster Creek and other local water bodies is impacted by stormwater drainage from a rapidly urbanizing area. Some creeks have an easement for City staff to perform maintenance, while some lie completely within private property. There has been some difficulty meeting environmental regulations and goals with neighbourhood resistance in some areas.

How did they respond?

The main focus of the pollution prevention efforts is through new commercial development and redevelopment designs and a strong partnership between the developers, the Town staff and neighbourhood representatives, and the Hamilton Region Conservation Authority.

Pollution Prevention Programs

- A new large commercial development is taking place in Ancaster. As part of the development process, roof water can be directed untreated to the storm sewers, but drainage from parking areas must be treated by the use of oil/grit, or other environmental engineering solutions. It is the responsibility of the owner to provide a maintenance plan and to carry out the necessary actions. Town staff have an easement on the new development which can be used to deal with reported problems.
- The use of filter strips, oil and grit separators, grassy swales, infiltration control and the use of existing ponds to control water volumes is encouraged with redevelopment.

- The Town's use of road salt, fertilizers, herbicides and pesticides has been reduced over the past several years. Road salting now is done successfully with a mix of 85% sand and 15% salt.
- Roads are ploughed quickly after snow events and there are few steep grades in the urbanized core. Pesticides and herbicides have not been used on Town properties for several years.
- An "Adopt a Road" project is being considered as part of a public anti-littering program.

Background Studies and Planning

In 1995, 60 municipalities were asked to comment on the draft Town of Ancaster stormwater management policy. Comments were studied and some of the recommendations already implemented.

Some progress is being made towards getting a common stormwater management policy for the City of Hamilton.

Staff Commitment

Because of limited staff and funding, environmental education and public outreach is built into the daily activities of the Town staff.

Public Education and Outreach

- **A neighbourhood representative** is included as an important part of the Committee dealing with the new commercial development. Stewardship and partnership is advocated and encouraged.
- **Information was provided by letter to residents with properties adjacent to Ancaster Creek**. This stressed the importance of the natural environment of the area and the negative impacts on the creek of some human activities. A repeat letter is being planned for the near future.
- **A Hazardous Waste program** is in effect in partnership with the municipalities of Flamborough and Stoney Creek. Monthly bulk waste pickups are made in all three communities. Residents are provided with information about disposal of household hazardous waste at a Hamilton depot.
- **A yearly calendar** is provided to all residents of Ancaster. This lists the dates of all Town garbage and recycling collection, leaf and Christmas tree pickups, community events, recreation registration and useful environmental information and phone numbers.
- **Environmental brochures and leaflets** from a variety of sources are available at the Town offices.
- **Yellow Fish Road Program.** Permission was given to a local group to carry out storm drain marking, but has not yet been implemented by the group.

THE CITY OF ST. CATHARINES

The City of St. Catharines:

- is situated along 25 kms of the south shore of Lake Ontario, and bounded on the south by the Niagara Escarpment;
- has a population of 130,000 in an area of 100 km^2;
- encompasses two major watercourses and over 25 urban creeks;
- is predominantly urban development;
- is responsible for local water supply and wastewater collection;
- is serviced with about 40% fully combined, 30% partially combined and 30% fully separated sewer areas;
- provides information and contacts at the website www.city.stcatharines.on.ca

What are the problems?

The older areas of St. Catharines have combined storm and sanitary sewer systems. During rainstorms, overflow points allow the excess water and dilute sewage to escape into local creeks causing bacterial pollution in the creeks and eventually impacting the City's four Lake Ontario beaches.

Basement flooding was also a chronic problem in combined and partially combined sewer areas because of this overloading.

There was an operational efficiency impact at the Water Pollution Control Plants as well as the added cost of treating large volumes of "clean" rainwater along with household wastes.

How did they respond?

Pollution Prevention Programs

Background Studies and Planning

The St. Catharines Area Pollution Control Plan (SCAPCP) was initiated in 1986 after a series of water quality discussions with the (then) Ontario Ministry of the Environment and Energy

(MOEE). Study management was broad-based and included most government agencies with jurisdictional responsibilities regarding the area's nearshore water quality. This included the MOEE, the Cities of St. Catharines and Thorold, the Region of Niagara and the Niagara Peninsula Conservation Authority. A major public consultation component was included.

The study area encompassed the linked combined, sanitary and storm sewer systems of the Cities of St. Catharines and Thorold. Jurisdiction is split with the Region of Niagara operating two Water Pollution Control Plants sited near the lakeshore, pumping stations and large inter-municipal trunk sewers. The two municipalities of St. Catharines and Thorold manage the remaining collection system. Land use, sewer servicing and pollutant loadings were evaluated. All surface waters in the study area were considered, and the four beaches were also assessed.

Between 1986 and 1990, the plan was formulated to manage water quality concerns and pollutant sources with a focus on controlling combined sewer overflows within the study area. SCAPCP was completed in June 1990 when the City Councils endorsed the recommendations of the Pollution Control Strategy.

The Strategy provides recommendations for almost $100 million of major pollution control capital works and prioritized implementation over twenty years. A Five Year Initiation Plan (FYIP) outlined annual programs for dry weather seepage abatement, water quality monitoring, downspout disconnection, water conservation, enhanced pet litter control and public education. The FYIP also included direction to carry out sewer infrastructure needs assessments in several high priority combined sewer catchment areas followed by construction of combined sewer overflow control facilities in lakefront areas.

In 1998, all of the annual programs were well established and the majority of recommended capital works are complete and operational. Three CSO retention facilities are in place. The costs for these facilities totalled about $6 million and funding partners included the Ministry of the Environment, the Region of Niagara, St. Catharines and Great Lakes 2000 Cleanup Fund (now Great Lakes sustainability Fund). Ongoing programs include:

- Dry Weather Seepage Pollution Abatement. A field survey in 1984 identified sixteen sewer pipes with dry weather effluent concerns. Problems related to minimal freeboard under dry weather conditions, trash rack maintenance for CSO drop-through grates, and residential cross-connections. The Cities of St. Catharines and Thorold undertook corrective actions.
- A field survey program was initiated in 1986 as part of pollution control planning to provide information on the quality and quantity of dry weather discharges from the area's outfalls. The program was initiated to identify outfalls receiving flows contaminated by illegal cross-connections of sanitary to storm sewers, commercial or industrial discharges, improper residential sanitary connections, septic tank overflows, or improperly functioning CSO regulators. The implementation of an annual program was recommended within the Strategy and an annual summer program was established in 1990. Immediate benefits were realized with eight significant dry weather pollutant sources eliminated for an estimated loading reduction of 13,000 fecal coliforms per second.

- The program continues each year to update the computer database and investigate priority outfalls. The program's benefits were greater initially since the solutions for identified problems were more obvious. Investigations now produce steady progress but remedial measures take longer to define and implement since the problems are usually complex, i.e., source identification in large catchment areas, grade incompatibilities between laterals and sanitary sewers, etc. A budget of $20,000 has been allocated in the past for remedial works. This has now been reduced since the pace of the investigations limits the spending of the budget. Some works require budget allocations and engineering and design in the following year.

Regulations and By-Laws

- City of St. Catharines By-Law 91-364 prohibits the direct connection and discharge of roof water into the municipal sanitary or combined sewer system.
- By-Law 83-80 requires dog owners to remove waste left by their dog on public or private property. There is a "passive" enforcement program to encourage citizens to act responsibility and clean up after their pet.

Staff Commitment

A Pollution Control Plan Section was created within the City of St. Catharines' Engineering Department. Three contract staff became permanent, and temporary and student staff is used to address periods of peak "work load" (e.g., up to 8 summer students). Participation in college/university/high school co-op or internship programs supplements staff without additional costs. In 1999, the permanent staff complement was increased by two positions.

Public Education and Outreach

A well-developed public education program focuses on promoting sound environmental practices by the homeowner. Typical presentations cover water conservation, household hazardous waste disposal, responsible pet litter disposal and overall environmental awareness. Public outreach programs include the following:

- **A City day** was held in 1997 and 1998, when City Hall was opened to the public on a Saturday. All the annual programs noted in this case study were represented at a staffed display seen by over 500 residents. Mall and library displays are held about five times each summer using student and other staff to present information on BMPs. No-cost advertising of public education events are aired on local radio stations during their community event listings. Display materials are periodically updated but otherwise materials are well stored and organized and are used for each session.
- **An annual beach and waterfront "clean up" day** is held to promote environmental awareness. This involves up to 300 school children and is organized by the City and the Niagara Peninsula Conservation Authority. The event is usually co-ordinated by a co-op student working from either office who provides teacher's information such as details on proper dress, safety issues and supervision requirements.
- **Information displays** are provided at two popular beaches. Informative, material on all of the Pollution Control Section activities is rotated throughout the summer season.

- **Environmental resource expertise** is provided by staff persons to the local community. For example, Niagara College has formed a committee of local technical advisors to assist with the development of environmental courses such as watershed management and aquatic habitat restoration. City staff provides a base of volunteer lecturers in relevant subjects. College and university mentorship is becoming an increasingly important component in the initial development of environmental projects.

- **School presentations** include both water conservation and pollution prevention topics. From 1996 to 2001, co-op students, sometimes federally or provincially funded, gave presentations to about 15,000 school children. Use is made of many educational materials available through municipal, provincial, federal, and technical associations as well as other sources. Brochures have been produced using the Environment Canada customized brochure software. Promotional materials used include pencils, magnets, stickers, posters and pamphlets.

- **Downspout Disconnection Program.** This has been one of the most successful and cost effective, pollution control programs. It focuses on education and enforcement to ensure that homeowners with downspouts discharging directly to combined or sanitary sewers disconnect and redirect them for discharge on their property. Based on earlier experience, it was not deemed cost effective to pay homeowners to disconnect downspouts and the success of voluntary disconnection was questionable. Prior to active enforcement of the City's sewer use by-law, an intensive public education campaign was carried out in 1991. Funding of $10,000 was received from the Clean Sweeps Program through the Ontario Ministry of the Environment.

  Preparations included:

  - A brochure, distributed to over 30,000 homes in combined or partially combined sewer areas.
  - A comprehensive display including a video and sample disconnection materials.
  - Mall displays presenting information and advice to interested citizens.
  - Printed materials such as community newsletters and inclusions in recreation program guides.
  - Media messages through the local newspaper and radio.

  The program began in 1992, with well-trained summer or temporary staff making "door-to-door" contact with residents in defined high priority sewer areas. Staff provided disconnection advice and available options, supplying information on swales, soakaway pits and rain barrels. Disconnection is not voluntary or optional, and no exceptions were made. Homeowners received three follow-up inspections before being referred for legal action. Legal action has not yet been taken in any instances given the consistently high compliance. A recent Ontario Court of Appeal decision, Oosthoeck v. Thunder Bay (1996) O. R. (2nd) 323, awarded damages to a plaintiff because the municipality did not enforce its 'downspout disconnection' by-law. This highlights the need for not only a by-law but also a downspout disconnection program.

Work on private property is not subsidized or supported in any other way than in an advisory capacity. Program costs are equivalent to a person per year, however the summer component usually involves two students that generally receive wage subsidies from provincial or federal sources. In 1998, over 11,500 homes were inspected and compliance was over 95% after the third inspection. A database contains information on all aspects of compliance and notification. An update for March 1999 shows 93.2% compliance for 14,757 records.

The program is labour intensive with hundreds of phone calls and kilometres logged. It has proven very effective and provides an educational opportunity at the grassroots level. Public support is positive and City Council continues to support the program despite several challenges.

The "theoretical" success of the program is gauged periodically by calculating the annual savings in terms of reduced sewage treatment cost based on the amount of rainfall diverted from direct discharge of roof water to the sanitary sewers. The biggest impact of the program is to "shave" the peak from sewer system response to intense rainstorms that will serve to reduce CSOs and alleviate basement flooding. Flow monitoring shows this is achievable, particularly in small catchments. In large catchments the results are not so apparent because of sewer system complexities and the impact of other inflow sources.

- **Flood Alleviation Project (FLAP).** A flow reduction program, started in 1991, is aimed at residents with basement flooding problems. Prerequisite for assistance is downspout disconnection and chronic flooding problems. A $150 fee must accompany each application and this is rebated once the FLAP measures are completed. A grant of $2,500 per applicant provides homeowners with basement flooding protection. This is achieved through the installation of backwater valves and disconnection of foundation drains from the combined/sanitary sewer system for discharge to the surface via sump pump. A provision for backup power supply is included as an eligible cost within the grant allocation. Work is carried out by local contractors in accordance with the Plumbing and Building Codes. The homeowner is also required to sign a waiver precluding municipal liability should any further basement flooding occur.

- Public education is a strong component of this program. Demonstration materials are taken to homes as requested. Follow-up visits are made to ensure commitment to the program. The program helps relieve localized sewer constraints and somewhat reduces the CSOs through the decrease in extraneous flows. In 1996, a year-round contract person was hired to oversee the program as part of their duties.

- Since 1994, FLAP has been funded solely by the City and has increased its budget allocation. From 1995 to 2001, about 270 residents have taken advantage of the program for a cost of about $600,000. The 1996 budget was exceeded with the occurrence of a 100-year storm. The 1998 budget was about $75,000 to accommodate 30 installations, which is expected to be sufficient unless there is another major flood. By March 1999, over two hundred homeowners had taken advantage of FLAP.

- **Pet Litter Program.** A "stoop and scoop" program has been operating, on and off, depending on funding and budget constraints. In 1992, 1994 and 1995, a summer student was dedicated to implementation at costs ranging from fully funded to about $3,000. The program is now incorporated into general summer student duties since it is fairly well researched and can be implemented satisfactorily without a dedicated co-ordinator.

- "Stoop and Scoop" bag dispensers and receptacles are provided to promote responsible pet care at the City's beaches, parks and walkways. A student stocks the dispensers weekly and conducts surveys of park users and dog walkers to determine the impact and support of the program. The annual budget allocation for the purchase of promotional materials and signs remains at $2,500.

  Dispoza-Scoops were also provided to area veterinarians and animal clinics in 1994 for distribution and their reaction was positive. Sponsorship for the scoop dispensers has been considered but the level of effort to initiate and maintain any arrangements was not considered cost effective in terms of the resultant reduction in pollutant loadings to local waters.

Policy Review and Recommendations

Financial Considerations and Support

The St. Catharines Area Pollution Control Plan Study costs totalled about $1.1 million, with the MOE contributing about 70% and the remaining funding contributed by St. Catharines, the Region of Niagara and Thorold.

Partnership and cost sharing efforts of the City and the Region of Niagara ($72,400) supported a computer modelling/flow monitoring assessment within the entire drainage catchment for one of the Water Pollution Control Plants. The study used 11 temporary sewer flow monitoring sites supplemented with 16 permanent regional sites throughout St. Catharines/Thorold, and $100,000 worth of flow monitoring equipment for permanent City sites. The premise for municipal support was alleviation of basement flooding.

Funding of $10,000 was received from the Clean Sweeps Program through the Ontario Ministry of the Environment for the Downspout Disconnection Program.

Municipal staff is focusing on developing partnerships, possibly on the private side to promote a type of "adopt a sewer" concept. A business development component will be an integral part of the Strategy to generate both funds and support from the community for continued implementation of Strategy recommendations. The municipality also implemented a 20% sewer surcharge in November 1996, based on water consumption. This surcharge is separate from the General Levy, and is used for water infrastructure management.

Monitoring and Evaluation

There are documented water quality improvements related to the St. Catharines lakefront beach area. Before 1994, the beaches were permanently posted with placards indicating swimming related health risks. Since 1994, the beaches have been are placarded between 50% to 70% of the summer season. Section staff sample five beach locations seven days per week. A database is maintained to track posted water quality, hazard notices on the beaches and to assess water quality. As well, sampling of the major watercourses continues with time of travel and water quality assessment carried out each year. Other monitoring programs are built into the Section budgets as required.

Both the Region of Niagara (16 sites) and the City of St. Catharines (8 sites in 1998; 4 sites in 1999) have established permanent telemetered flow monitoring within the City.

Water Efficiency Programs

Background Studies and Planning

The implementation of a water conservation program was not considered within the Strategy, however, an annual summer program was established for the residential sector in 1993. Water efficiency is built into the overall public outreach program. The goal of the program is to optimize the operation of the combined and sanitary sewer systems' operations by reducing the clean water flows from the private side.

Staff Commitment

In 1993, the first summertime program began with an Environmental Youth Corp (EYC) funded student. Initially a research component was included to provide the basis to develop a program.

Public Education and Outreach

- Educational programs are carried out by summer students and EYC participants in summer camps and in the fall, in local schools. These include:
  - An initial contact with the school curriculum services department.
  - Classroom presentations on the hydrologic cycle, water conservation, wastewater treatment, the use and installation of water saving devices, and reinforcing puzzles and games.
  - A see-through toilet demonstration.
  - Distribution of 100 water conservation kits as demonstration material and prizes during presentation.
  - Distribution of magnets, posters, stickers or pogs for teachers and students.

  Each year program co-ordinators are required to document procedures, text for presentations, contacts, and recommendations for next year's program. Students are hired more for "people skills" than technical knowledge.
- Through public education efforts, homeowners are provided with information to enable them to lower their water and hydro bill (by reducing the amount of hot water used). Although this results in lost municipal revenue, the benefit is achieved by reducing pressures on the water treatment, distribution, sanitary and wastewater systems and the potential of prolonging the life of the infrastructure.

Financial Considerations and Support

The cost for the 1996 school and summer camp education program was about $14,500 for partially subsidized staff and $1,500 for promotional materials. Since fall 1998, the program has been run year round with co-op students (fall and winter) and summer students.

A Port Dalhousie CSO Abatement Study was carried out in 1999, and cost-shared between the City and the Region of Niagara. This will refine the recommendations of the 1990 Pollution Control Strategy.

THE REGIONAL MUNICIPALITY OF WATERLOO

The Regional Municipality of Waterloo:

- includes the Cities of Cambridge, Kitchener and Waterloo and the Townships of North Dumfries, Wellesley, Wilmot and Woolwich;
- is responsible for water supply, wastewater operations and waste management;
- has a total population of 426,700 (1997 figures);
- is 1,382 sq. km in area with 14% urban and 86 % rural land use;
- is part of the drainage area of the Grand River watershed;
- is serviced with separate storm and sanitary sewers systems apart from some areas in Woolwich Township;
- provides information and contacts through the website www.region.waterloo.on.ca

What are the problems?

Municipal water supply is provided by an integrated system of 90% groundwater and 10 % surface water. The long-term sustainability of the Region's water resources depends on the quality and quantity of the recharge to the groundwater aquifers and the Grand River. Concerns include the potential of the present water resources to accommodate future population growth in the Region and the impacts of rural and urban point and non-point source pollution on the water supply.

The Region of Waterloo promotes water conservation and water efficiency programs as a supplementary means of conserving and sustaining the vital groundwater supplies of the area.

How did they respond?

Pollution Prevention Programs

Background Studies and Planning

- A comprehensive Water Resources Protection Strategy was implemented in 1994, with the objective of limiting risk to water resources from historic, current and future land uses. A series of tasks and programs are being implemented over a ten-year period. These include:

- Regional scale hydrogeologic studies to provide the technical basis for detailed studies to determine the capture zones for individual wellfields.
- A Preliminary Capture Zone Study for some of the 55 wellfields with a time period of six years to complete detailed studies of other wellfields.
- A Reconnaissance Inventory of Potential Contaminant Sources used existing data to establish relative risk on a broad scale to water resources from potential sources of contamination.
- A Detailed Inventory at the Middleton Street Wellfield provided a list of businesses within the capture zone that may be potential sources of contamination.

- A Draft Groundwater Protection Awareness and Education Program for the Industrial, Commercial and Institutional Sector Plan was prepared in 1998 for incorporation into the Water Resource Protection Plan. This sector is considered to be the main contributor to existing urban water pollution. The plan objectives are:

  a) increase industry/business awareness and understanding of water as a resource,

  b) facilitate and encourage individual/collective action to protect water resources.

Regulations and By-Laws

A Regional Sewer Use By-Law (1-90) mandates levels of toxic material in sewer discharges. The biggest problem with industrial, commercial and institutional users is sewer pipe maintenance. Site inspectors test regularly for enforcement and there are heavy fines for non-compliance.

Staff Commitment

Since 1994, the Program has been implemented with full time commitment of a manager, three hydrogeologists, and one hydrogeological technician. Summer students and university co-op students are used on occasion for some very focussed projects.

Public Education and Outreach

- **A Water Resource Protection Liaison Committee** was formed in 1994. Members of this umbrella group include representatives from regional staff (Planning, Engineering and Health), regional councillors, business, environmental and agricultural interests.

  Working groups were formed for the following areas:

  - Future Urban Point Sources (FUPS)
  - Current Urban Point Sources (CUPS)
  - Rural Non-Point Sources

  The Future Urban Point Source group focuses on the Region's authority to influence future development in a proactive manner to prevent groundwater quality problems. *(see Policy Review and Recommendations).*

  The Current Urban Point Source group focuses on increasing public awareness of the Region's water resources and promoting voluntary resource protection in urban businesses and industries. Activities include the following pilot projects:

1) The preparation and distribution of a survey to one wellfield area's businesses to prepare an inventory of potential contaminant sources. Co-op students distributed the survey, with personal visits, follow-up phone calls and an excellent 85% response rate. These responses provide a future base for contact and may be used to monitor the effectiveness of the approach.

2) BMP fact sheets for individual industries. Draft sheets are being prepared for two industries (metal fabricating and veterinary) in two city wellfield areas.

3) An information package for area businesses. This will include a poster for a communal work area, information on pollution control and BMPs.

4) Policy review (see Policy Review and Recommendations).

Rural Non-Point Sources. The Rural Water Quality Program initiative began in April 1998 and ends December 31, 2002. Financial assistance up to $25,000 is available to qualified rural landowners in the Region to share the cost of implementing selected BMPs that improve water quality. Financial assistance ranges from 50% to 75% depending on the project. Cost share grants are available for milkhouse waste, manure handling and chemical storage improvements, restricting livestock access to watercourses, improvements to water wells, and control of field erosion.

A preliminary survey for the Rural Water Quality Initiative was undertaken in 1997 as a pilot project. An information kit was first sent to 200 rural homes followed by a questionnaire to determine if the information about water quality improvements had been read and if any of the recommendations were implemented. The response rate was 25%, which may have been somewhat higher if scheduled during a less busy time for farmers.

Waterloo Region committed $1.5 million from user rates to the program. Additional funds are supplied by the National Soil and Water Conservation Program and the Grand River Conservation Authority. The program is delivered by staff from the Grand River Conservation Authority and was developed with consultation with many agricultural associations and the Stewardship Network.

- **Environmental Business Source**. This networking group was developed through the Ontario Centre for Environmental Technology Advancement. The Region is sponsoring the set-up of the program and will step back once it is developed and functioning well. The focus is on information sharing, networking and contacts that will assist small business by providing no-cost expertise.
- **Groundwater Guardian Communities**. Woolwich, Cambridge and Wilmot are participating with full council and some staff support.
- **Household Hazardous Waste** awareness programs and Hazardous Waste disposal schedules at the Regional Waste Management Facility. Publications include *Environews*, a newsletter about many facets of waste reduction, hazardous waste disposal and conservation practices. Other publications include brochures on household and garden practices, pesticide use, etc., and children's environmental colouring books.

Policy Review and Recommendations

The following policy reviews are being carried out by the Future Urban Point Source group:

- Develop Regional Official Plan amendments to establish Wellhead Protection Areas and identify acceptable and unacceptable land uses in these areas.

- Work with Area Municipalities to implement Regional Official Policies Plan policies through appropriate means such as zoning by-laws and development approvals.
- Evaluate existing Provincial, Regional or Area Municipal regulations as a mechanism for regulating future land use activities (including the use of specific chemicals).

The following policy reviews are being carried out by the Current Urban Point Source group.

- Evaluation of current Provincial, Regional and area municipal regulations which might provide a regulatory basis to require the use of BMPs in Wellhead Protection Areas, similar to the Regional sewer use by-law or health regulations.
- Evaluation of the need for financial incentives to encourage businesses to implement BMPs.
- Develop a plan to target household hazardous waste collection (depots and/or advertising).
- If necessary, advocate the development of new Provincial or Regional regulations to ensure adequate groundwater protection.

Financial Considerations and Support

The estimated costs presented in **Table 1,** are sufficient to fund identified projects but the Implementation Plan does not include funds for financial incentives which may be required to implement protection policies and programs. The types of and need for financial incentives was evaluated from 1996-1998. The 10-year capital forecast is reviewed annually and revised if necessary to incorporate new information and changing priorities.

Table 1.0: Water Resource Protection Costs for the Regional Municipality of Waterloo

Water Resource Protection Costs from 1996 and a Ten Year Forecast		
Year	**Current Capital Budget (includes a small portion of expenses funded by Wastewater)**	**Percentage of Total Water Supply Budget. (excluding debt charges)**
1996	$1,587,000	4.3%
1997	$ 915,000	2.7%
1998	$ 915,000	2.6%
1999	$ 915,000	3.5%
2000	$ 765,000	3.1%
2001	$ 315,000	1.3%
2002	$ 215,000	.6%
2003	$ 215,000	.6%
2004	$ 215,000	.6%
2005	$ 215,000	.7%

Monitoring and Evaluation

No formal monitoring program was undertaken in 1998. Monitoring will be a component incorporated into the draft Groundwater Protection Awareness and Education Program for the Industrial, Commercial and Institutional Sector.

Water Efficiency Programs

Background Studies and Planning

A Master Plan for Water Efficiency was developed by regional staff with input from a Water Efficiency Advisory Committee. The Master Plan sets water reduction targets for ten years and determines what programs will be used. The programs must be feasible, economically viable and environmentally beneficial. The Plan was completed in September, 1998 and includes the following components:

- projected water demands,
- climate and rainfall statistics,
- water consumption,
- capital expansion and needs,
- water efficiency measure in use and planned,
- education and public input.

Staff Commitment

Dedicated full-time staff time includes a manager and a water efficiency co-ordinator. A co-op student during the winter and a summer student provide extra staffing. A proposal to add a full-time program assistant is being considered this year.

Public outreach staff are chosen for their proven communication skills. Conferences (Ontario Water Works Association, American Water Works Association, and the Conserve Conference) are regarded as valuable areas to gain information about new technology, approaches and solutions. Committee liaisons, for example the Water Efficiency Committee, are also regarded as valuable.

Public Education and Outreach

- **A Water Efficiency Advisory Committee** provides input to the Master Plan and program development. Members include university, political, industrial and community (neighbourhood) representation. An economist advises on budget needs.
- **An information phone line** is available for public queries and concerns. Many brochures, information leaflets, refrigerator magnets and publications about house and garden water-saving techniques have been produced and distributed. Recommended water saving practices include rainbarrel installation, downspout direction to lawns and gardens, naturescaping or xeriscaping, and household water conservation with showers, laundry and other BMPs. Media coverage and relations has been positive. Speakers are provided to community groups on request.

- **School programs** are used to educate future residents. These include curriculum-based projects with two school boards, from K1 to Grade 8. Teacher's kits, materials, video and a class visit by a speaker are available on request. The curriculum is developed and updated on an ongoing basis.

  School children take home water saving devices such as shower head adapters, toilet dams and shower timers. This program is most effective when there is a follow up required as homework to monitor the actual placement and use of the devices.

- **A Toilet Replacement Program** was used twice with differing rates of success. The initial program took place several years ago in two smaller rural communities (St. Jacobs and Elmira) and was not considered a success. There was little preplanning, no open houses or demonstration sites, and no information brochures. Community resources such as plumbers and hardware suppliers were not used and there was little fixture choice. On the positive side, some monitoring was done through water bill records as the communities are 100% metered. It was found that the toilet replacement program achieved a 20% to 30% reduction in water use and was a long-term benefit, while reduction devices achieved only a 0% to 9% reduction rate.

- A more successful on-going program uses a rebate incentive of $50 per household toilet replacement, with local contractors supplying the new low-flush toilets. Regional staff inspect the installments for conformance to the water saving criteria and pick up the old toilets for recycling. The rebate is then mailed to the householder.

  The program is aimed only at retrofitting as the Ontario Building Code specifies low-flush toilets in new developments. Each year 7,000 toilets are replaced, and it is expected that in ten years only low flush toilets will be in use.

- **An Industrial Water Audit Kit** was produced and is available under licence to other municipalities. The "Saving Water" kit was completed in 1992 and updated in 1996. The kit recommends the development of an employees' committee to carry out the audit, a technique that produces more support from the staff. A one-day workshop can be added with consultant guidance and set up. Kits have already been sold to London, the City of Toronto, Greater Vancouver District and the City of Vancouver. There is also an annual mailing on water efficiency in the workplace.

Financial Considerations and Support

A budget of approximately $520,000 is allocated from 1999 to 2008 for the Water Efficiency Program.

Monitoring and Evaluation

The Region of Waterloo is participating in the American Water Association Research Foundation end user study. In July 1997, twelve communities in North America put data loggers on 100 homes for summer and winter periods. The areas logged in the Region are Cambridge and Waterloo. Data is analysed to give information on residential water use. The preliminary results are already useful, and the final data was ready in the summer of 1998. Preliminary results show that toilets are the heaviest year round water users, and water softeners are also large water users.

Long Term Planning

The Water Resource Protection Strategy implemented in 1994 will continue to provide directions for the following ten-year period. Financial commitments will be reviewed annually and revised to accommodate new information and changing priorities.

The Master Plan for Water Efficiency will provide guidance and direction from 1998 for a ten-year period. Other future considerations include water-pricing changes. At present, water is wholesaled by the Region to the municipalities of Kitchener, Waterloo, Cambridge, North Dumfries, Woolwich, Wilmot and Wellesley. All seven areas have different pricing rates and billing systems. The Region will try to involve the municipalities in an overall water rate plan reviewing facets of each system and seasonal differentials. A group choice may then be made or the billing can be incorporated into the wholesale costs.

Monitoring and Evaluation

Reduction of sewage flows is not expected to be significant at this time since water conservation practices involve lifestyle and behaviour changes and the target group is the next generation.

THE CITY OF HAMILTON

The City of Hamilton:

- is situated at the west end of Lake Ontario, with Hamilton Harbour forming a major part of its waterfront;
- includes the communities of Hamilton and Stoney Creek, Towns of Ancaster, Dundas and Flamborough, and Township of Glanbrook;
- has a population of 460,000 and an area of 1,120 sq. km;
- includes the City of Hamilton which has mostly combined sewers discharging to streams and Hamilton Harbour; other municipalities have separate systems;
- can be contacted through the website at http://www.city.hamilton.on.ca/

What are the problems or issues?

Water and sediment quality degradation in local streams and Hamilton Harbour. Hamilton Harbour is an Area of Concern and a Remedial Action Plan has been developed.

Concern about toxic contaminants in the water, air and soils.

Mandate to develop a sustainable community.

Interest in pollution prevention and better management of the environment.

How did they respond?

- Pollution Control Plan
- Pollution Prevention Plan
- Environmental Management System

1. Pollution Control Plan for the City of Hamilton

Primarily directed at the combined sewer overflow problem in the City of Hamilton. The study, completed in 1991, recommended a combination of improvements including storage tanks, and increased interceptor capacity for in-line storage. Flow reduction using downspout disconnection was analysed with a predicted reduction of storage requirements of 5%. Several large storage tanks have been constructed that have reduced overflows. A demonstration project has been completed to evaluate the use of real-time control operation of the system to further reduce overflows and avoid construction of some additional tanks.

References

Pollution Control Plan for the Regional Municipality of Hamilton-Wentworth, Paul Theil Associates and Beak Consultants, December, 1991.

2. Comprehensive Pollution Prevention Plan (CPPP)

The CPPP was initiated in 1993 jointly with the former Regional Municipality of Hamilton-Wentworth, Environment Canada and the Ontario Ministry of the Environment and Energy. The project was considered the first of its kind and was established to demonstrate how pollution prevention programs could be incorporated into municipal government operations and programs.

The goals of the project were to:

- look at the Region's internal operations to ensure that its own house was in order;
- encourage local residents, communities and businesses to practise pollution prevention through leadership and the Region's ability to regulate and influence certain activities;
- share results with other communities.

The benefits of this approach of incorporating pollution prevention programs into a municipality's programs are as follows:

- Environmental - Combining environmental issues with business decisions is a proactive approach to environmental protection;
- Fiscal - Costs are reduced through efficient use of resources;
- Reduced Risk and liability - Changing to products which are less harmful to the environment reduces risk to workers and the environment;
- Improved Corporate Image - Relations with stakeholders and staff are improved;
- Impact on Other Sectors - Ability to influence businesses, suppliers, and the community to adopt pollution prevention.

Steps in Developing a Pollution Prevention Plan

This figure indicates the recommended steps to be followed in developing a PP plan in a cycle of continuous improvement. The steps are detailed below:

Step 1 - Getting Started - What is needed to initiate a Pollution Prevention Plan process.

- Identify funding sources and get support from management and council.
- Assemble a team including a senior management "champion".
- Develop a flexible work plan.
- Set an environmental policy.
- Begin informing and involving the players.

The City of Hamilton Corporate Environmental Policy:

We believe that a healthy environment is an essential component of becoming a sustainable community and will strive to be exemplary in our environmental performance. Our commitment is:

- To meet and exceed all environmental standards and legal requirements, and the reasonable expectations of Regional taxpayers in the management of Regional Operations and services.
- To address environmental implications of all activities, decisions, and expenditures in concert with economic and social considerations.
- To promote environmental conservation and protection in all our internal operations.
- To encourage all employees to be conscious of environmental considerations and be protective of the environment in their work and personal lives.
- To give highest priority to actions that result in the elimination or reduction of waste at the source (pollution prevention).
- To conduct an annual evaluation of our progress in implementing our environmental goals and policy and report on the results at the Annual Sustainable Community Day.
- To re-evaluate and improve approaches, as required based on the annual evaluation of progress.
- To work with the community, area municipalities, businesses, suppliers, contractors, and other partners to encourage environmentally sound practices and activities.

Step 2 - Taking Inventory

- Evaluate current status of environmental impacts.
- Develop strategy to collect information.
- Complete inventory of selected areas to establish a baseline to measure the results of changes.

Step 3 - Identifying Opportunities

- Set goals and objectives for the pollution prevention.
- Set priority areas using inventory information.
- Identify opportunities to reduce or eliminate water at the source.
- Screen and evaluate options.

Step 4 - Turning Your Plan into Action

- Select opportunities for implementation with targets and timelines.
- Assign responsibilities.
- Document plan and get approvals.
- Train educate and motivate staff.

- Take action.

Step 5 - Monitoring and Evaluation

- Keep track of progress.
- Communicate results.
- Evaluate performance.
- Repeat process.

Lessons Learned

The reference provides good advice for other municipalities embarking on the same course. Some of these are:

- support from all levels is critical to success, especially senior staff;
- understand the position of those being asked to change - their perspective on environmental protection whether environmental, budgetary, planning, or operations affects how they interpret the pollution prevention message;
- use the inventory to generate ideas to act upon quickly;
- use less traditional approaches to make limited resources go as far as possible, eg. Forming a partnership with the federal and provincial governments, and the introduction of pollution prevention as a tool to achieve compliance with the Regional Sewer Use By-Law;

It was noted in the report that there is no formal management plan that links pollution prevention with other business aspects of the Region. This could be addressed through an Environmental Management System, which incorporates pollution prevention.

An extensive reference and resources list is provided in the primary reference - A Guide to Pollution Prevention for Municipalities, Regional Municipality of Hamilton-Wentworth, 1996, available from: The Canadian Centre for Pollution Prevention, 265 Front St. Suite 112, Sarnia, Ont., N7T 7X1. E-mail info@c2p2online.com

Environmental Management System for the Regional Environment Department

The Region Environmental Department (RED) in 1997 initiated development of an Environmental Management System using the ISO 14001 approach.

The RED mandate includes five core businesses:

- Treatment and distribution of potable water.
- Collection and treatment of wastewater.
- Collection of stormwater in the City of Hamilton (includes the combined sewer system).
- Management of solid waste.
- Management and development of growth.

The purpose of the EMS development was to:

- sustain existing environmental management processes;
- improve the corporate image;
- strengthen environmental compliance;

- identify opportunities and enhance environmental awareness.

Steps being followed in developing the EMS include getting started, in which the Regional Environmental Policy stated above was augmented by a Mission Statement (see box) for the RED.

Environmental Mission Statement

The Regional Environmental Department is committed to working toward the goals of VISION 2020 and Regional Council's Environmental Policy. We will continually improve our environmental performance to sustain and protect our human and natural community by strengthening positive effects and reducing negative ones as we deliver our services to the community. Signed January 1998.

Key to the startup was a Communication Program for staff which included newsletters, open houses, site visits with operations crews, meetings with staff, unions and Regional councillors, and the formation of working groups to address issues. A Gap Analysis was performed to identify environmental issues (or aspects, using ISO 14001 terminology). A highly interactive process with staff was used to perform the gap analysis in order to define significant gaps where legal or other requirements were not being met. The procedure first identifies activities, services and operations of the RED in carrying out its mandate. Environmental aspects and impacts are then identified from each, and also the defined legal and other requirements that must be met. Significant gaps were defined as "Any issue of non-conformance with the Department's legal and other requirements".

From the defined significant gaps, an EMS Action Plan was developed. This included creating an information management system, setting short term objectives and targets, and initiating pilot plans for contract management of solid wastes; water-main break and repair; valve inspection; and EMS manual. The pilot plans would assist in applying the EMS approach to the remainder of the department.

The EMS took 2½ years to complete as certification and was completed in 1999. Some of the lessons learned in developing the EMS this far are:

- keep it simple - make sure the scope is manageable and flexible;
- get senior management on the same page, i.e., agreeing on the scope and direction of the EMS;
- break down barriers immediately with ongoing communication and training;
- designate or identify champions sooner.

It was also recognized early on that products of the gap analysis and priority setting can be used immediately in the discussion of budget priorities and work planning. In other words, benefits can be derived from the process before the EMS itself is completed.

THE CITY OF TORONTO

The City of Toronto:

- is a densely populated urban area located on the north shore of Lake Ontario;
- had a land area of 97 km² prior to 1998 and a population of 653,378 (1995 figures*);
- was amalgamated in January 1998 with the municipalities of East York, North York, Scarborough, York and Metro Toronto to form the new City of Toronto with a combined population of 2.4 million;
- is part of the watersheds of the Don and Humber Rivers, and Highland and Mimico Creeks;
- is responsible for water supply and wastewater removal;
- services 75,000 properties with combined building drains, and 56,000 properties with separated building drains;
- provides information on the website www.city.toronto.on.ca

**All figures are applicable to the area before amalgamation in 1998.*

What are the problems?

Water quality in the Don and Humber Rivers and in Lake Ontario is being impacted by sewer overflow discharges during heavy rainstorms. The majority of homes, schools and businesses in the City, (75,000 properties) have roof areas which drain directly to the Toronto, Scarborough and East York neighbourhood's combined sewers through a single combined drain. During rainfall events, the roof areas contribute approximately 95% of the flow entering the combined drain, which may range from 20 to 30 times the amount of dry weather flow. This significant increase in flow is a major contributor to combined sewer overflows. Basement flooding due to backup of combined sewers is also a problem in some areas of the City.

How did they respond?

The City of Toronto embarked on a program to separate road storm sewers from sanitary sewers. The program has resulted in the partial separation of 70% of the total combined sewer drainage area. As redevelopment occurs in the area, new developments are required to completely separate the private drainage system.

A major Downspout Disconnection Program was implemented in 1996 to reduce the frequency of combined storm sewer overflows and basement flooding. Other responses to the problems include active water efficiency and water use reduction programs to reduce the volume of water entering the sewers and the wastewater treatment plants, and eastern and western storage tunnel construction.

Pollution Prevention Programs

Background Studies and Planning

A Sewer System Master Plan was developed by City staff, with a recommendation that a Downspout Disconnection Program be implemented over a period of 20 years. A pilot project in 1992 involved 93 homes and achieved disconnections on 51% of the eligible properties (8 homes were already disconnected and 39 volunteered to participate). A high rate of participation is believed due to the direct benefit derived by homeowners in this area who have experienced basement flooding.

Another pilot project achieved a lower rate of participation with 61 out of 1,090 homeowners signing participation agreements. Residents in both pilot areas demonstrated an interest on the part of the homeowners to help reduce the storm sewer overflows and improve water quality.

Based on experience and soil and site considerations it was estimated initially that about 20% to 30% of property owners might participate.

Regulations and By-Laws

An amendment to By-Law 78-91 was made to require the infiltration of stormwater run-off into the ground in the case of all new buildings and re-developments, except in cases where soil or site conditions are unsuitable for infiltration. Disconnection became legal with the provision that if water hazards resulted on streets and driveways, there may be reconnection.

Staff Commitment

The Downspout Disconnection program is delivered with a full time staff equivalent of 9.5 persons. Partnerships with community organizations and volunteer assistance have been used at times with the program.

Public Education and Outreach

A Downspout Disconnection Program was promoted on a voluntary basis. The program started in East Toronto as a response to complaints about basement flooding. Program publicity included the distribution of flyers, a Home Depot exhibition, and posters and presentations. A glossy handout with a recognizable symbol proved useful at exhibitions while a more detailed information package provided a better response during door-to-door promotions. It was felt that the original glossy handout did not provide enough information for the householder.

The disconnection program includes a property permeability assessment by City agents. A City contractor performs the disconnection at no cost to the homeowner and installs a rain barrel at the homeowner's request. Rain barrels initially cost $75 for a 214-litre size, and $120 for a 565-litre rain barrel. A "do-it-yourself" option is provided, with disconnection being performed by the homeowner who receives a 565-litre rain barrel free of charge. Approximately 2,000 properties are disconnected each year.

A permission agreement is signed before work is carried out. The agreement includes the following provisions:

- An acknowledgement on the part of the owner that water may run overland and the owner will be responsible for maintaining safe sidewalk conditions. The City may also, at its expense, require the homeowner to reconnect the downspouts.
- An agreement that the City will carry out any remedial work such as remedying wet basement walls and/or icy conditions which are necessary in the opinion of the Commissioner of City Works Services, as a result of the initial work. This agreement remains in force for a period of two years after the disconnection.

Financial Considerations and Support

The Downspout Disconnection program budget is $1.5 million annually. In 1996 and 1997, a fee-for-service contract for inspections was made with the Greensaver organization with provisions of funding of $100 for every agreement signed. The total contract was $156,000.

An estimated 6,500 properties are to be included in the program each year. The predicted participation rate is 30% (2,000 properties) with an average cost per disconnection, including soak-away pits installations where necessary, of $580 per property.

Budget details included:

Property disconnection costs at 2,000 x $580 =	$1,160,000
Estimated administrative =	$1,160,000
Public Awareness Campaign =	$20,000

A Non-Structural Working Group (later renamed the Stormwater Group) was appointed by City Council in 1996 as a response to a directive from the Ministry of the Environment and Energy as a condition for rescinding the requirement for a full Environmental Assessment for the proposed Western Beaches Storage Tunnel. The group includes members of the public and agencies, and their mandate includes the following:

- identify areas of the City where implementation of natural systems rainwater management is possible;
- identify alternative methods for stormwater management and combined sewer overflow and water pollution alleviation;

The Stormwater Group reviews current City policies and programs, and assists in the review of options for techniques, policy options and implementation sites in conjunction with City staff.

The Stormwater Group, in its first formal report to Toronto City Council (May 1997), recommended the initiation of three projects to determine opportunities and feasibility of source control SWM. In February 1998, three different groups of consultants were chosen to examine options for new programming and policies based on three test neighbourhoods.

- North Bloor West Village
- Moore Park/North Rosedale
- Garrison Creek

The three test neighbourhoods were evaluated by a consultant team and a Steering Committee, which included local citizens. Each study team completed an assessment of the area including public and private land use, biophysical characteristics, population demographics and stormwater flow modeling. Each team carried out an extensive public consultation.

The three consultant groups reported in February 1999 with recommendations for revisions to the Downspout Disconnection program, new initiatives for each neighbourhood and citywide policy recommendations. The Stormwater Group will establish a work plan to implement selected projects from the three reports. A more detailed analysis of findings follows.

Demonstration Site Findings

North Bloor/West Village

The study area included approximately 4,000 single-family dwellings, with a mix of institutional, single, and multi-family dwellings, and a population of approximately 23,000. A high percentage of roof leaders were already disconnected (21%).

Barriers to Action

Through focus groups and a telephone survey of 150 residents, the key barriers to adoption of stormwater reduction techniques were identified as physical (94 mentions). These included lack of space, inappropriate site conditions including shared driveways.

Financial considerations were the next most frequently mentioned barrier. Cost was perceived to be a significant consideration in replacement of paved surfaces and installation of soak-away pits, and less, although still important, for the installation of rain barrels.

Other barriers included perceived problems such as concerns regarding flooding, ice accumulation, odours and mosquito breeding. Twenty respondents felt that a lack of knowledge, tools or physical ability was a barrier. Appearance was a concern for 16 respondents, and level of effort required was a barrier for 12 respondents.

Awareness of Stormwater Issues

- 85% were highly aware that stormwater pollution affects Lake Ontario.
- Most residents (91%) believe that water conservation is good for the environment.

Willingness to Act

- 71% have already implemented at least one method of reducing stormwater pollution and many are willing to do more.
- 63% are willing to disconnect downspouts, and 57% to install rain barrels.
- 86% participate in water conservation actions.

Moore Park/North Rosedale

Public consultation methods and information used included two public meetings/workshops (presentations, discussion, questionnaires); phone surveys; consultation with appropriate environmental groups; detailed socioeconomic data obtained from Statistics Canada; personal contact with area residents; and the results of the "Downspout Disconnection Program – Delivery Strategy Report".

Audience

Well-educated, professional families in a high-income neighbourhood. There was strong pride in home ownership, a well-developed sense of community and high community standards.

Willingness to participate

HIGH-rated SWM measures, based on resident's willingness to implement, were tree planting, rain barrels, porous paving, lawn aeration, and water metering.

MEDIUM-rated: backyard ponds, grassed swales, and infiltration trenches.

LOW-rated: below ground cisterns, rooftop gardens, and shallow marshes.

- The majority (76%) said the Downspout Disconnection (DD) Program should be incentive-based.
- 50% said the incentives should be financially based.
- 37% said that more information, advice and assistance would make them act.
- 75% felt that public lands, (parks etc.) should be used to demonstrate "lesser known" stormwater management practices.
- Many are bewildered by the current DD program and lack an overall understanding of SWM context and an understanding of program limitations.

Media and Messages

- 88% said public education is important or very important to SWM issues.
- 94% felt that these issues should be integrated into the school curriculum.
- The top 5 media selected by respondents:
  - personal letter by mail (88%),
  - flyer or brochure by mail (66%),
  - insert in tax or water bill (63%),
  - personal phone call with follow up (63%),
  - community newspaper ad (38%), and
  - The lowest ranked included the City website, in store video, and the daily paper.

Modelling/Engineering Simulation Results (Potential Conditions)

- A 25% disconnection (1 in 4) of existing downspouts within the Sighthill Avenue combined sewer area would reduce the average number of CSOs by almost 50%.
- The Moore Park area is partially separated with road storm sewers installed for approximately 75% of the system. Consequently, roofs are the main source of runoff to the combined sewer. With this partial control, combined sewer outflows occur an average of 9 times per year.
- While disconnecting 2/3 of the remaining downspouts would increase the annual stormwater runoff to the Yellow Creek ravine by approximately 1%, the annual CSO volumes would be reduced by more than 15 times.

- The more each area is partially separated with road storm sewers installed for approximately 75% of the system. Consewuently, roofs are the main source of runoff to the combined sewer. With two partial control, CSOs occur on average 9 times per year.

Surface Infiltration Rates

- Field measurements on typical residential lawns have shown that surface infiltration rates can be doubled if the surface is aerated. On an annual basis, such increase in infiltration rates would reduce the surface runoff volumes by approximately 4%.

Benefits of SWM Methods on CSOs

- The use of rain barrels has little effect in reducing the number of annual CSOs unless the overflow from the rain barrels is directed to a grass area.

  Benefits of using rain barrels are:

  i. source of water for watering lawns and flowers, and

  ii. reduction of 65% to 70% in the occurrence of roof runoff going directly to lawns.

- Underground storage tanks or subsurface infiltration trenches can, if properly sized, significantly reduce the annual number of CSOs. For example, if a $1m^3$ of storage per 35 m^2 of roof area could be provided within the Sighthill Avenue combined sewer system, annual CSOs could be reduced by 64% - to less than 3 per year.

Garrison Creek

By looking at a series of connecting rainwater strategies, starting with the single house, park, street and schoolyard, to a connected stormwater community of blocks, schoolyards and open spaces, an overall reduction of stormwater runoff of 43% can be achieved across this demonstration site.

Water Efficiency Programs

Policy Review and Recommendations

Water Conservation Standards and Policies for new development are being implemented including the development of guidelines for preparation of the Water Conservation Plan. This involved the submission of a water conservation plan by the building owner as part of the development review and permit approval process.

Staff Commitment

The Water Efficiency/Conservation Program has a full time staff equivalent of four people.

Public Outreach and Education

Water efficiency programs undertaken by the City of Toronto include:

- **Water saving retrofit kits** were distributed to approximately 50,000 homes having a water meter installed and to condominiums that ensure the kits will be installed within a stated time period.

- **A Universal Metering Program** provides for the installation of approximately 4,000 water meters. This includes metering of new construction or buildings where the water service is repaired or replaced, and voluntary residential metering.
- **Metering Sizing and Replacement Programs** involve data base analysis of accounts to identify improperly sized meters, followed by on-site monitoring and replacement. This reduces previously unaccounted water use and increases City revenues.
- **Water Conservation Curriculum Supplements** have been developed and made available for school grades 4-6 and K-3, with approximately 5,000 students participating each year. This program includes the following elements:
    - Water Saving Kits were distributed to students;
    - Classroom presentations, water activity days and tours of water and waste management facilities;
    - Provision of teacher's workshops and development of a Leader's Guide.
- **A Water Efficiency Training Manual** for City of Toronto Schools was developed including conducting training workshops for plumbers and caretakers. Training manuals were also developed for City plumbing staff and swimming pool operators.
- **A Water Efficiency in the Workplace Manual** was developed jointly with the Region of Waterloo for the industrial, commercial and institutional sectors. This includes guidelines on how to conduct water audits and develop employee involvement programs.
- **Media and transit shelter advertising**, press releases and bill stuffers to encourage metering.
- **A Water Efficiency Display** was produced with working models of a toilet and shower for use at malls, schools and environmental events.
- **Videos and slide presentations** relating to water efficiency, downspout disconnection, etc., are available to renovators, community groups, and public information forums.
- **Brochures and information leaflets** are available on a wide variety of topics including Wise Lawn Care.

Monitoring and Evaluation

A survey was undertaken of door-to-door water saving kit distribution customers (previously metered) versus newly metered customers to determine the use and effectiveness of the kits.

TORONTO WATERSHED INFRASTRUCTURE ECOLOGY PROGRAM (WIEP)

The Watershed Infrastructure Ecology Program (WIEP)—Toronto, Ontario.

WIEP is a part of the City of Toronto's Task Force initiatives to improve water quality in the Don River.

- The City of Toronto is a densely populated urban area located on the north shore of Lake Ontario and is part of the watersheds of the Don and Humber Rivers, and Highland and Mimico Creeks. The City is responsible for water supply and wastewater removal, and services 75,000 properties with combined building drains, and 56,000 properties with separated building drains.
- WIEP can be contacted at (416) 392-1983, www.riversides@riversides.org or www.h2info.org

The Watershed Infrastructure Ecology Program (WIEP) was developed in 1995 as part of the City of Toronto Task Force To Bring Back The Don. The residential campaign, *Five Things You Can Do For The Don*, consisted of more than five municipal and non-profit programs but was characterized as such because of its emphasis on five principles: disconnect, clean, create, conserve, and call.

The program incorporated residential, commercial and institutional components. These include the City of Toronto downspout disconnection and rain barrel program; the City of Toronto water metering and conservation; and the Toronto Environmental Alliance household toxics self-audit. Each initiative was delivered free of charge or at minimal cost.

Residential Project

A Water Quality Canvass was used to increase program participation; educate the public; and raise awareness of lot level retrofit source control measures and non-point source pollution prevention BMPs. The canvass was designed by Kevin Mercer, Environmental Equity Consultants, and Elizabeth Bruckmann of the Task Force. Social marketing techniques were used to provide diverse organizational components that highlighted the importance of NPS pollution prevention. Canvassers provided crucial links between the programs and the health of the river, the cost of municipal infrastructure, and residential stewardship. A community presence was built through community events, media articles, posters and signs, preliminary pamphlet drops, and a comprehensive campaign brochure.

The Water Quality Canvass also acted as a data collection process that cross-correlated with the monitoring of flow management. All contact and sign-up data were collected in a single database reflecting the householder response form filled out by canvassers.

Monitoring and Evaluation

The Watershed Infrastructure Ecology Program (WIEP) evaluated the response rate to the voluntary downspout disconnection program in specified areas in 1996 and 1997. The first two seasons of the Water Quality Canvass achieved a higher than anticipated response rate. A total of 6,257 residents were canvassed, with the greatest numbers participating through the downspout disconnect program.

A total of 1,098 expressions of interest were generated. Of these, 983 were inspected and 491 disconnection agreements were sent to owners of suitable properties. WIEP estimates that at least 100 households undertook self-disconnection prior to city inspection. There is no calculation for the number of houses that self-disconnected after being rejected as unsuitable by city inspection.

The results of the WIEP canvas include:

- The Rain Barrel component shifted focus dramatically during the campaign. Of the households requesting downspout disconnections, roughly 75% requested a rain barrel. Initially, barrels were charged for as an add-on to the Downspout Disconnection program. Rain barrel design and purpose underwent a major shift during the program, as did public acceptance and expectations. The early barrel design was replaced with a more suitable barrel that did not require winter maintenance. Canvassers found that householders were more receptive to rain barrels than to downspout disconnections *per se*.
- Water metering was a hard sell for most householders not already metered due to the long term cost implications. WIEP created a handout describing the cost savings for a family of four from metering as compared to flat rate. A toilet tank bank incentive was offered to all canvassed households in addition to the estimated 250 water-metering installations and conservation kits.
- The staff easily addressed barriers to comprehension, although a lack of discretionary authority hampered the flexibility of staff where questions were raised about program implementation.
- The major barrier to participation for the downspout disconnection program was the permeability criteria used by city inspectors to determine whether or not a house could be disconnected. The city's prohibition against run-off to sidewalks considerably reduced the acceptable number of disconnects, and some residents disagreed with the recommended disconnect route or method.
- It is difficult to compare the effectiveness of the canvass in directly raising awareness through participation because of changes to the program over the period of the canvass. For example, rain barrels changed from being an option to an integral program component. Rain barrels changed in cost, size, shape and colour, and inspections criteria varied with the nature of the neighbourhood.
- Voluntary programs, while extremely appealing on a number of grounds, do not guarantee high levels of environmental protection. A mandatory program might secure disconnections on an additional 20,000 to 70,000 properties, depending on physical feasibility and cost effectiveness.
- Initially, a participation rate of 30% was predicted, while an actual participation rate of 8% has been generated through contact with over 100,000 homeowners since the program was introduced.
- "In person" initial contact was more successful than mailings in generating participation.

- The importance of clear messages in brochures and written communications is stressed with the key hurdles being product awareness and understanding. Information materials should reinforce the recognition of the public and private benefits accrued to homeowners.

Sewershed Flow Monitoring was used by the City of Toronto, with six flow monitors placed in the three sewersheds being canvassed. The Riverdale/Playter Estates monitors were fine tuned to capture a specific sub-sewershed with the intention of illustrating detailed flow reductions from a specific site. The gauges were installed for a two-year period with the objective of capturing the base flow and comparing its changes over time with the sign-up rate of the canvass. These goals were unfulfilled after it was discovered that the monitoring required either a very large area with a correspondingly large participation rate for disconnections, or a more detailed monitoring method to account for the finer changes that the system in place could not handle.

Among the difficulties encountered with the flow monitoring regime were the variable meteorological conditions of the years measured. Whereas 1996 had some of the largest rain events ever recorded for a summer, 1997 and 1998 were drier than usual. Monitors installed in September 1996 missed the majority of the large 1996 rain events. Nonetheless, the sign-ups and inspection process required more than a six-month period to process the backlog of inspections requests. It could not be determined whether the reduced flow was a result of the completion of the canvass disconnection sign-ups or from other factors. Monitors were pulled before the completion of the program to use in the base-flow monitoring program for the Stormwater Group demonstration study areas.

GLOSSARY OF WATER RELATED TERMS

Anaerobic - Describes an organism or metabolic process that functions in the absence of air, or, more precisely, in the absence of molecular oxygen.

Aquifer – A porous water bearing geologic formation generally restricted to materials capable of yielding an appreciable supply of water

Backfill - Earth used to fill a trench or an excavation.

Backwashing - Reversing the flow of water back through the filter media to remove the entrapped solids.

Baffles - Fin-like devices installed vertically on the inside walls of liquid waste transport vehicles that are used to reduce the movement of the waste inside the tank.

Bankfull Flow - The condition where streamflow fills a stream channel to the top of the bank and at a point where the water begins to overflow onto a floodplain.

Barrel - The closed conduit used to convey water under or through an embankment; part of the principal spillway.

Base flow - The portion of stream flow that is not due to storm runoff, and is supported by groundwater seepage into a channel.

Bedload - The sediment in a stream channel that mainly moves by jumping, sliding or rolling on or very near the bottom.

Benthos - In freshwater and marine ecosystems, the collection of organisms attached to or resting on the bottom sediments, and those which bore or burrow into the sediments.

Berm - An earthen mound used to direct the flow of runoff around or through a structure.

Best Management Practice (BMP) – A structural or non-structural device designed to temporarily store or treat stormwater runoff in order to mitigate flooding, reduce pollution and provide other amenities.

Bioaccumulation - A process where chemicals are retained in fatty body tissue and increase in concentration over time. The accumulation of chemicals in the tissue of species higher in the natural food chain increases as contaminated food species are eaten.

Biochemical oxygen demand (BOD) – The quantity of oxygen consumed during the biochemical oxidation of matter over a specified period of time (see also COD).

Biodegradable - The ability to break down or decompose under natural conditions and processes.

Biofilters - A collection of living organisms (bacteria), growing on small particles or substrates which give a very large surface area. Biofilters are used as a watertreatment and waterquality method. The biofilter has requirements that must be met if the bacteria are to survive and function.

Biomass - The total quantity or weight of organisms (living matter) in a given area or volume.

Bioretention - A water quality practice that utilizes landscaping and soils to treat urban stormwater runoff by collecting it in shallow depressions before filtering through a fabricated planting soil media.

Bioretention Areas - Area to mimic the functions of wooded wetlands removed by land development

Biosolids - The nutrient-rich organic materials resulting from the treatment of sewage sludge.

Bioventing - The process of inserting air into the soil matrix due to withdrawing soil gas from the recovery well.

Brownfield Sites - Existing development areas, primarily commercial and industrial. Can also refer to a way of redevelopment. May include existing residential areas as well as infilling, depending on the context. This item is generally used in the discussion of providing stormwater management, best management practices, or site remediation cleanup to control runoff from older uncontrolled "brownfield" areas.

Buffer Strip or Zone - Strips of grass or other erosion-resistant vegetation between a waterway and an area of more intensive land use.

Calibration - A check of the precision and accuracy of measuring equipment.

Catchbasin - Box-like underground concrete structure with openings in curbs and gutters designed to collect runoff from streets and pavement.

Catchment Area - Also referred to as drainage basin, a catchment area is an area drained by a stream or other body of water. The limits of a given catchment area are the heights of land-often called drainage divides, or watersheds-separating it from neighboring drainage systems. The amount of water reaching the river, reservoir, or lake from its catchment area depends on the size of the area, the amount of precipitation, and the loss through evaporation (determined by temperature, winds, and other factors and varying with the season) and through absorption by the earth or by vegetation; absorption is greater when the soil or rock is permeable than when it is impermeable. A permeable layer over an impermeable layer may act as a natural reservoir, supplying the river or lake in very dry seasons. The catchment area is one of the primary considerations in the planning of a reservoir for water-supply purposes.

Cementitious Coatings - A coating of cement (portland cement by-products or calcium aluminates) that can be used to prevent leaks on defective manholes.

Channel - A natural stream that conveys water; a ditch or channel excavated for the flow of water.

Channel erosion - The widening, deepening, and headward cutting of small channels and waterways, due to erosion caused by moderate to large floods.

Channel Stabilization - Erosion prevention and stabilization of velocity distribution in a channel using jetties, drops, revetments, structural linings, vegetation and other measures.

Check dam - (a) A log or gabion structure placed perpendicular to a stream to enhance aquatic habitat. (b) An earthen or log structure, used in grass swales to reduce water velocities, promote sediment deposition, and enhance infiltration.

Chemical oxygen demand (COD) – A monitoring test that measures all the oxidizable matter found in a runoff sample, a portion of which could deplete dissolved oxygen in

Chlorinated Hydrocarbons - Recognized as carcinogens and mutagens, and contribute to global warming and ozone depletion. Includes trichloroethylene, perchloroethylene and methylene chloride.

Cistern - A tank for storing water.

Clarifier - A large circular or rectangular tank or basin in which water is held for a period of time, during which the heavier suspended solids settle to the bottom. Clarifiers are also called settling basins and sedimentation basins.

Compaction (SOILS) - Any process by which the soil grains are rearranged to decrease void space and bring them in closer contact with one another, thereby increasing the weight of solid material per unit of volume, increasing the shear and bearing strength and reducing permeability.

Conduit - Any channel intended for the conveyance of water, whether open or closed.

Contaminant - Constituents of the air, water or soil which render them unsuitable for their intended use. Such agents may be chemicl or biological in anture and may result from natural forces, life processes of other species, or our own acitivies.

Conveyance – Any natural or manmade channel or pipe in which concentrated water flows.

Corrosion – The dissolving and wearing away of metal caused by a chemical reaction such as between water and the pipes that the water contacts, chemicals touching a metal surface, or contact between two metals.

Culvert - A covered channel or a large-diameter pipe that directs water flow below the ground level.

Curbs - Concrete barriers on the edges of streets used to direct stormwater runoff to an inlet or storm drain and to protect lawns and sidewalks from vehicles.

Dam - A barrier to confine or raise water for storage or diversion, to create a hydraulic head, to prevent gully erosion, retention of soil, sediment or other debris.

Dechlorination - The deliberate removal of chlorine from water. The partial or complete reduction of residual chlorine by any chemical or physical process.

Denitrification - Bacterial reduction of nitrite to gaseous nitrogen under anaerobic conditions.

Design storm - A rainfall event of specific size, intensity, and return frequency (e.g.,. the 1-year storm) that is used to calculate runoff volume and peak discharge rate.

Detention - The temporary storage of stormwater to control discharge rates, allow for infiltration, and improve water quality.

Detention Structure – A permanent structure for the temporary storage of runoff that is designed to temporarily pool water.

Detention time - The amount of time a parcel of water actually is present in a BMP. Theoretical detention time for a runoff event is the average time parcels of water reside in the basin over the period of release from the BMP.

Dethatching - Involves the removal of the matted layer of dead and decaying plant material between growing grass and the soil.

Dewatering - A process for removing excess water from solids to lessen the overall weight of the wastes.

Dike - An embankment to confine or control water, for example, one built along the banks of a river to prevent overflow to lowlands; a levee.

Discharge - A release or flow of storm water or other substance from a conveyance or storage container.

Diversion - A channel with a supporting ridge on the lower side constructed across the slope to divert water to areas where it can be used or disposed of safely. Diversions differ from terraces in that they are individually designed.

Downspout - A pipe which carries rainwater from a roof to a drain or to ground level.

Draft EA - A document which a proponent can opt to submit, before submission of a formal EA document to the Minister, so that issues or concerns respecting the documentation can be resolved between the proponent and the reviewers before the formal submission.

Drainage - 1. The removal of excess surface water or ground water from land by means of surface or subsurface drains. 2. Soil characteristics that affect natural drainage.

Drainage Area (Watershed) – That area contributing runoff to a single point measured in a horizontal plane, which is enclosed by a ridge line.

Ecosystem - A community of plants and animals within a particular physical environment which is linked by a flow of materials through the non-living as well as the living sections of the system.

Emission – Pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities and from motor vehicle, locomotive, or aircraft exhausts.

Environment - Environment means: (i) air, land or water; (ii) plant and animal life, including man; (iii) the social, economic and cultural conditions that influence the life of man or a community; (iv) any building, structure, machine or other device or thing made by man; (v) any solid, liquid, gas odour, heat, sound, vibration or radiation resulting directly or indirectly from the activities of man, or; (vi) any part or combination of the foregoing and the interrelationships between any two or more of them.

Enviro Whirl - a dry vacuum sweeper exhausted through cartridge filters, and various other street sweeping machines

Erosion - 1. The process by which the land surface is worn away by the action of water, wind,ice, or gravity. 2. Detachment and movement of soil or rock fragments by water, wind, ice or gravity. The following terms are used to describe different types of water erosion:

Erosion Gully - The erosion process whereby water accumulates in narrow channels and removes the soil from this narrow area to considerable depths ranging from 1 or 2 feet to as much as 75 to 100 feet.

Erosion Rill - An erosion process in which numerous small channels only several inches deep are formed. See rill.

Erosion Sheet - The spattering of small soil particles caused by the impact of raindrops on wet soils. The loosened and spattered particles may or may not subsequently be removed by surface runoff.

Evapotranspiration - The loss of water from the soil both by evaporation and by transpiration from the plants growing in the soil.

Excavation – The process of removing earth, stone, or other materials.

Exfiltration - The downward movement of water through the soil; the downward flow of runoff from the bottom of an infiltration BMP into the soil.

Extended Detention - A stormwater design feature that provides for the gradual release of a volume of water in order to increase settling of pollutants and protect downstream channels from frequent storm events

Facility - Is a collection of industrial process discharging storm water associated with industrial activity within the property boundary or operational unit.

Fecal coliform bacteria - Minute living organisms associated with human or animal feces that are used as an indirect indicator of the presence of other disease causing bacteria.

Fertilizer – Materials such as nitrogen and phosphorus that provide nutrients for plants. Commercially sold fertilizers may contain other chemicals or may be in the form of processed sewage sludge.

Filter Fabric – Textile of relatively small mesh or pore size that is used to (a) allow water to pass through while keeping sediment out (permeable), or lb) prevent both runoff and sediment from passing through (impermeable).

Filter Strip – Usually long, relatively narrow area of undisturbed or planted vegetation used to retard or collect sediment for the protection of watercourses, reservoirs, or adjacent properties.

First Flush - The delivery of a disproportionately large load of pollutants during the early part of storms due to the rapid runoff of accumulated pollutants. The first flush of runoff has been defined several ways.

Floodplain - Areas adjacent to a stream or river that are subject to flooding or inundation during a storm event that occurs, on average, once every 100 years (or has a likelihood of occurrence of 1/100 in any given year).

Fluorometric - a unit of measurement when undertaking dye testing.

Forebay - Storage space located near a stormwater BMP inlet that serves to trap incoming coarse sediments before they accumulate in the main treatment area.

Geology - The study of the earth: its origin, history, structure, composition, and the natural process acting on it.

Geosynthetic Liners - Synthetic fibers that are made into a flexible, porous fabric for separation, reinforcement, filtration, drainage or a moisture barrier.

Grading - The cutting and/or filling of the land surface to a desired slope or elevation.

Greenway - A linear open space; a corridor composed of natural vegetation. Greenways can be used to create connected networks of open space that include traditional parks and natural areas.

Ground Cover - Plants which are low-growing and provide a thick growth which protects the soil.

Groundwater - Water stored underground in the pore spaces between soil particles or rock fractures.

Gully - A channel or miniature valley cut by concentrated runoff through which water commonly flows during and immediately after heavy rains or snow melt. The distinction between gully and rill is one of depth. A gully is sufficiently deep such that it would not be obliterated by normal tillage operations, whereas a rill is of lesser depth and would be smoothed by ordinary farm tillage or grading activities.

Habitat - An area or type of area that supports plant or animal life.

Halogenated VOCs - Volatile Organic Chemicals (VOCs) that are chemically composed of chlorine, bromine, or iodine. VOCs evaporate readily to the atmosphere and contributes to photochemical smog production and certain health problems.

Hazardous Substance - 1. Any material that poses a threat to human health and/or the environment. Hazardous substances can be toxic, corrosive, ignitable, explosive, or chemically reactive.

Hazardous Waste - By-products of human activities that can pose a substantial or potential hazard to human health or the environment when improperly managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or appears on special EPA lists.

Herbicide - A pesticide toxic to plants, used to kill weeds or other unwanted vegetation.

Heterogeneities - Soil that is varying in structure or composition at different locations in the area.

Hydrocarbon - A chemical compound that consists entirely of carbon and hydrogen.

Hydrogeology - The branch of geology dealing with underground and surface water.

Hydrology - The science dealing with the waters of the earth, their distribution on the surface and underground, and the cycle involving evaporation, precipitation, flow to the seas, etc.

Illicit Connection - Any discharge to a municipal separate storm sewer that is not composed entirely of storm water except discharges authorized by an NPDES permit (other than the NPDES permit for discharges from the municipal separate storm sewer) and discharges resulting from fire fighting activities.

Impervious Area - A hard surface area (e.g., parking lot or rooftop) that prevents or retards the entry of water into the soil, thus causing water to run off the surface in greater quantities and at an increased rate of flow.

Infiltration - 1. The penetration of water through the ground surface into sub-surface soil or the penetration of water from the soil into sewer or other pipes through defective joints, connections, or manhole walls. 2. A land application technique where large volumes of wastewater are applied to land, allowed to penetrate the surface and percolate through the underlying soil.

Infiltration Rate (f) - The rate at which stormwater percolates into the subsoil measured in inches per hour.

Inflow - The water (other than wastewater from sanitary sewers) entering the sanitary or combined sewer system from the surface through downspouts, catchbasin maintenance hole covers, and cross connections to storm sewers.

Inlet - An entrance into a ditch, storm sewer, or other waterway.

Interevent Time - Dry period between storms.

Irrigation - Human application of water to agricultural or recreational land for watering purposes.

Lagoon - A shallow pond where sunlight, bacterial action, and oxygen work to purify wastewater.

Landfills - An area of land or an excavation in which wastes are placed for permanent disposal, and which is not a land application unit, surface impoundment, injection well, or waste pile.

Leaching - The process by which soluble constituents are dissolved in a solvent such as water and carried down through the soil.

Level Spreader - A device used to spread out storm water runoff uniformly over the ground surface as sheetflow (i.e., not through channels) to prevent concentrated, erosive flows from occurring and to enhance infiltration.

Liner - 1. A relatively impermeable barrier designed to prevent leachate from leaking from a landfill. Liner materials include plastic and dense clay. 2. Insert or sleeve pipes to prevent leakage or infiltration.

Live Fascines - A bank protection measure consisting of bound and staked rolls of live willow and dogwood cuttings which are laid in trenches that run along the tops of stream banks. The vegetative cuttings grow quickly to establish a shrubby riparian edge that helps to shade the creek and resist bank erosion. The new riparian vegetation also provides habitat for a variety of wildlife.

Live Crib Walls - A bank protection structure in which logs are spiked together and backfilled with soil. Live stakes are planted between the logs. The logs act to retain the soil which when compacted provides a moderate mass for retaining steep slopes. The vegetative cuttings provide shade and erosion protection. These walls are used where habitat is essential at areas of severe slope.

Low flow channel - An incised or paved channel from inlet to outlet in a dry basin which is designed to carry low runoff flows and/or baseflow, directly to the outlet without detention.

Master Plans - Master Plans are long range plans, integrating infrastructure requirements for present and future land use with environmental planning principles. These plans examine the whole infrastructure system in order to outline a framework for planning for subsequent projects and/or developments.

Material Storage Areas - Onsite locations where raw materials, products, final products, byproducts, or waste materials are stored.

Methanogenic - The formation of methane by certain anaerobic bacteria during the process of anaerobic fermentation.

Microclimate - The climate of those parts of the lower atmosphere directly and immediately affected by the features of the earth's surface.

Mitigation - The activities carried out, or proposed, by a proponent of an undertaking to minimize or ameliorate the environmental effects of the undertaking.

Monitoring - The activities carried out by the proponent after approval of an undertaking to determine the environmental effects of the undertaking ("effects monitoring"). Monitoring can also refer to those activities carried out by the MOE in ensuring that a proponent complies with the EA as accepted and the terms and conditions of the approval of the undertaking ("compliance monitoring"). "Effectiveness monitoring" is a third type of monitoring in which a proponent evaluates how effectively its class EA parent document or proposal, plan or program EA is working in the planning and implementation of its class EA projects or constituent undertaking, respectively.

Municipal Act - Provides municipalities with the authority to enact by-laws for "prohibiting, regulating and inspecting the discharge of any gaseous, liquid or solid mattter into land drainage works, private branch drains and connections to any sewer, sewer system or sewage works for the carrying away of domestic sewage or industrrial wastes or both, whether connected to a treatment works or not.

Naturalization - Involves working with natural materials such as live vegetation and natural flow deflectors (strategically placed rock or root wads from old trees that are placed along the band) to create a self-repairing bank.

Naturescaping - Naturescaping is a way of inviting wildlife into your backyard by using native plants that provide shelter, food, and water for our urban wildlife neighbors

Nitrification - The biochemical transformation of ammonium nitrogen to nitrate nitrogen.

Nonpoint Source Pollution - Pollution that does not come from a point source. Nonpoint source pollution originates from aerial diffuse sources that are mostly related to land use.

Off-Line - A management system designed to control a storm event by diverting a percentage of stormwater events from a stream or storm drainage system.

Oil and Grease Traps - Devices which collect oil and grease, removing them from water flows.

On-Line - A management system designed to control stormwater in its original stream or drainage channel.

Open Space - Land set aside for public or private use within a development that is not built upon.

Organic Solvents - Liquid organic compounds capable of dissolving solids, gases, or liquids.

Outfall -The point, location, or structure where wastewater or drainage discharges from a sewer pipe, ditch, or other conveyance to a receiving body of water.

Outlet - The point at which water discharges from such things as a stream, river, lake, tidal basin, pipe, channel or drainage area.

Ozonation - The application of ozone to water for disinfection or for

taste and odor control.

Pan Lysimeters - Collect soil water as it percolates down via gravity through saturated soils. This device only gathers fluids under saturated gravity flows. A lysimeter is a device for collecting water from the pore spaces of soils and for determining the soluble constituents removed in the drainage.

Particulate - The solid/liquid particals which are in the air and are usually made up of the chemicals or materials from the original source.

Permeability - The quality of a soil that enables water or air to move through it. Usually expressed in inches/hour or inches/day.

Permeable - Soil or other material that allows the infiltration or passage of water or other liquids.

Permit - An authorization, license, or equivalent control document issued by EPA or an approved State agency to implement the requirements of an environmental regulation; e.g., a permit to operate a wastewater treatment plant or to operate a facility that may generate harmful emissions.

Pesticide -a natural or synthetic agrochemical used to kill organisms that are harmful to cultivated plants or animals.

Phenolic - Compounds with at least one hydroxyl-substituted aromatic ring system.

Phytoremediation - the use of trees and plants to help clean up toxic waste sites

Point Source - Any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural storm water runoff.

Pollutant - Any dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discharged equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water.

Polyureas - A non-corrosive coating that provides a infiltration barrier.

Porous Pavement - A human-made surface that will allow water to penetrate through and percolate into soil (as in porous asphalt pavement or concrete). Porous asphalt pavement is comprised of irregular shaped crush rock precoated with asphalt binder. Water seeps through into lower layers of gravel for temporary storage, then filters naturally into the soil.

Precipitation - Any form of rain or snow.

Proposal, Plan Or Program EA - An EA for a group of related undertakings and/or initiatives which are proposed collectively to achieve the same purpose.

PVC (Polyvinyl Chloride) - A plastic used in pipes because of its strength; does not dissolve in most organic solvents.

Rain Barrels - Barrels designed to collect and store rooftop runoff.

Recharge Rate - Annual amount of rainfall which contributes to groundwater as a function of hydrologic soil group.

Reclaim (water reclamation) - Planned use of treated effluent that would otherwise be discharged without being put to direct use.

Recycle - The process of minimizing the generation of waste by recovering usable products that might otherwise become waste. Examples are the recycling of aluminum cans, wastepaper, and bottles.

Redevelopment - Any construction, alteration, or improvement exceeding five thousand square feet of land disturbance performed on sites where existing land use is commercial, industrial, institutional, or multifamily residential.

Rehabilitation - To restore to good or normal condition

Remedial - Fix a problem. i.e. remedial action on a stream to improve erosion conditions.

Remediation - Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a (Superfund) site.

Residual - Amount of pollutant remaining in the environment after a natural or technological process has taken place, e.g., the sludge remaining after initial wastewater treatment, or particulates remaining in air after the air passes through a scrubbing or other pollutant removal process.

Retention - The amount of precipitation on a drainage area that does not escape as runoff. It is the difference between total precipitation and total runoff.

Retrofit - The modification of storm water management systems in developed areas through the construction of wet ponds, infiltration systems, wetland plantings, stream bank stabilization, and other BMP techniques for improving water quality. A retrofit can consist of the construction of a new BMP in the developed area, the enhancement of an older storm water management structure, or a combination of improvement and new construction.

Return interval - A statistical term for the average time of expected interval that an event of some kind will equal or exceed given conditions (e.g., a stormwater flow that occurs every 2 years).

Reuse (water reuse) - (see Reclaim)

Riparian - A relatively narrow strip of land that borders a stream or river, often coincides with the maximum water surface elevation of the 100 year storm.

Riparian Area - Vegetated ecosystems along a waterbody through which energy, materials, and water pass. Riparian areas characteristically have a high water table and are subject to periodic flooding.

Riparian Habitat - Areas adjacent to rivers and streams that have a high density, diversity, and productivity of plant and animal species relative to nearby uplands.

Roughness Coefficient (Hydraulics) - A factor in velocity and discharge formulas representing the effect of channel roughness on energy losses in flowing water. Manning's "n" is a commonly used roughness coefficient.

Runoff - That part of precipitation, snow melt, or irrigation water that runs off the land into streams or other surface water. It can carry pollutants from the air and land into the receiving waters.

Sanitary Sewer - A system of underground pipes that carries sanitary waste or process wastewater to a treatment plant.

Sanitary Waste - Domestic sewage.

Secondary Containment - Structures, usually dikes or berms, surrounding tanks or other storage containers and designed to catch spilled material from the storage containers.

Sediment Trap - A device for removing sediment from water flows; usually installed at outfall points.

Sedimentation - The process of depositing soil particles, clays, sands, or other sediments that were picked up by flowing water.

Sediments - Soil, sand, and minerals washed from land into water, usually after rain. They pile up in reservoirs, rivers, and harbors, destroying fish-nesting areas and holes of water animals and cloud the water so that needed sunlight might not reach aquatic plants. Careless farming, mining, and building activities will expose sediment materials, allowing the rain to wash them off the land.

Sheet Flow - Water, usually storm runoff, flowing in a thin layer over the ground surface.

Slide Gate - A device to control the flow of water through storm water conveyances.

Sludge - A semi-solid residue from any of a number of air or water treatment processes. Sludge can be a hazardous waste.

Slurry - A pasty liquid containing solid in suspension.

Soil - The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of plants.

Soakaway Pit - A pit into which liquids may flow and then percolate slowly into the subsoil.

Source Control - A practice or structural measure to prevent pollutants from entering storm water runoff or other environmental media.

Stakeholder - Any person, agency or group who has a direct interest in the purpose of a proposed undertaking.

Stopcock Valve - A small valve for stopping or controlling the flow of water or other liquid through a pipe

Stormceptor - Manufacturer of stormwater quality treatment devices.

Storm Drain - A slotted opening leading to an underground pipe or an open ditch for carrying surface runoff.

Storm Water – Storm water runoff. snow melt runoff. surface runoff. and drainage. It excludes infiltration.

Stormwater Ponds - A land depression or impoundment created for the detention or retention of stormwater runoff.

Stormwater Wetlands - Shallow, constructed pools that capture stormwater and allow for the growth of characteristic wetland vegetation.

Stratigraphy - The order and relative position of strata, which is a layer or set of successive layers of any deposited substance.

Streamflow - Water flowing in a natural channel, above ground.

Sump - A pit or tank that catches liquid runoff for drainage or disposal.

Superfund Sites - In the United States, sites under remediation or clean-up invoked by the CERCLA (Comprehensive Environmental Response Compensation and Liability Act, Superfund Act) and/or SARA. The "cradle to grave law" is applied holding that the generator of waste is responsible for proper waste disposal and provides for any cleanup of the contaminated sites by the government, with the cost of cleanup being charged to the responsible parties. Basically a generator becomes responsible for waste from it's inception until it has been destroyed.

Surface Capping - A layer of clay, or other impermeable material installed over contaminated soil to prevent the entry of rainwater, eliminate direct exposure to contaminated soils, and minimize leachate and the emission of soil gases.

Surface Water - All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, wetlands impoundments, seas, estuaries, etc.); also refers to springs, wells, or other collectors which are directly influenced by surface water.

Suspended Solids - The portion of total solids retained by a filter.

Swale - An elongated depression in the land surface that is at least seasonally wet, is usually heavily vegetated, and is normally without flowing water. Swales direct storm water flows into primary drainage channels and allow some of the storm water to infiltrate into the ground.

Thalweg - Line joining the lowest points of successive cross-sections, either along a river channel or, more generally, along the valley that it occupies. More specifically, a thalweg is the line of the fastest flow along the course of a river. This usually crosses and recrosses the stream channel.

Topography - The physical features of a surface area including relative elevations and the position of natural and human-made features.

Total Phosphorus (TP) – The total amount of phosphorus that is contained within the water column.

Total Suspended Solids (TSS) - The total amount of particulate matter that is suspended in the water column.

Toxin - A poison produced by an organism.

Treatment - The act of applying a procedure or chemicals to a substance to remove undesirable pollutants.

Tributary - A river or stream that flows into a larger river or stream.

Turbidity - Describes the ability of light to pass through water. The cloudy appearance of water caused by suspended and colloidal matter (particles).

Two-Year Storm - The 24 hour storm event which exceeds bankfull capacity and occurs on average once every two years (or has a likelihood of occurrence of 1/2 in a given year).

Underground Storage Tanks (USTs) - Storage tanks with at least 1 0 percent or more of its storage capacity underground.

Urbanization - Changing land use from rural characteristics to urban (city-like) characteristics.

Ultrafiltration - The process in which hydrostatic pressure causes water and small dissolved molecules and ions to move across a membrane against a concentration gradient.

U.V. Disinfection - A process of disinfecting that involves subjecting the item, object, or instrument to ultraviolet radiation.

Volatize - To cause to pass off in vapour.

Waste - Unwanted materials left over from a manufacturing or other process.

Water Surface Profile - The longitudinal profile assumed by the surface of a stream flowing in an open channel; the hydraulic grade line.

Water Table - The upper surface or top of the saturated portion of the soil or bedrock layer, indicates the uppermost extent of groundwater.

Watershed - The topographic boundary within which water drains into a particular river, stream, wetland, or body of water.

Waterway - A channel for the passage or flow of water.

Wet pond - A stormwater management pond designed to detain urban runoff and always contain water.

Wet Well - A chamber used to collect water or other liquid and to which a pump is attached.

Wetlands - An area that is regularly saturated by surface or ground water and subsequently is characterized by a prevalence of vegetation that is adapted for life in saturated soil conditions. Examples include: swamps, bogs, fens, marshes, and estuaries.

Wind Break -Any device designed to block wind flow and intended for protection against any ill effects of wind.

Xeriscaping - a method of landscaping using rock gardens, cacti, and other plants that thrive in dry environments as a means to conserve water.

APPENDICES

A Ontario CSO Control Procedure

B Disposal Alternatives - Quick Reference Table

C Available Public Outreach Materials

APPENDIX A – ONTARIO CSO CONTROL PROCEDURE

PROCEDURE F-5-5

DETERMINATION OF TREATMENT REQUIREMENTS FOR MUNICIPAL AND PRIVATE COMBINED AND PARTIALLY SEPARATED SEWER SYSTEMS

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1. RATIONALE

Procedure F-5-5 is a supporting document for Guideline F-5 "Levels of Treatment for Municipal and Private Sewage Treatment Works Discharging to Surface Waters".

A Combined Sewer System (CSS) is a wastewater collection system designed to convey both sanitary wastewater and stormwater runoff through a single-pipe system to a sewage treatment works. During dry weather, it conveys sanitary wastewater. During a precipitation event (rainfall or snowmelt) the capacity of the CSS and/or treatment facility may be exceeded by the total wastewater flow. This results in the occurrence of a combined sewer overflow (CSO) which is an untreated mixture often containing high levels of floatables, pathogenic microorganisms, suspended solids, oxygen-demanding organic compounds, nutrients, oil and grease, toxic contaminants and other pollutants. The CSOs represent a potential health hazard and can have adverse effects on aquatic life, recreational uses and water supplies. The goals of this Procedure are to:

(a) eliminate the occurrence of dry weather overflows

(b) minimize the potential for impacts on human health and aquatic life resulting from CSOs

(c) achieve as a minimum, compliance with body contact recreational water quality objectives (Provincial Water Quality Objectives (PWQO) for Escherichia coli (E. coli)) at beaches impacted by CSOs for at least 95% of the four-month period (June 1 to September 30) for an average year.

2. DEFINITIONS

A "combined sewer system (CSS)" is a wastewater collection system which conveys sanitary wastewaters (domestic, commercial and industrial wastewaters) and stormwater runoff through a single-pipe system to a Sewage Treatment Plant (STP) or treatment works. Combined sewer systems which have been partially separated and in which roof leaders or foundation drains contribute stormwater inflow to the sewer system conveying sanitary flows are still defined as combined sewer systems in this Procedure.

APPENDIX A

A "combined sewer overflow (CSO)" is a discharge to the environment from a combined sewer system that usually occurs as a result of a precipitation event when the capacity of the combined sewer is exceeded. It consists of a mixture of sanitary wastewater and stormwater runoff and often contains high levels of floatables, pathogenic microorganisms, suspended solids, oxygen-demanding organic compounds, nutrients, oil and grease, toxic contaminants and other pollutants.

An "overflow event" occurs when there is one or more CSOs from a combined sewer system, resulting from a precipitation event. An intervening time of twelve hours or greater separating a CSO from the last prior CSO at the same location is considered to separate one overflow event from another.

"Dry weather flow" is sewage flow resulting from both:

(i) Sanitary wastewater (combined input of industrial, domestic and commercial flows); and

(ii) Infiltration and inflows from foundation drains or other drains occurring during periods with an absence of rainfall or snowmelt.

"Wet weather flow" is the combined sewage flow resulting from:

(i) Sanitary wastewater; and

(ii) Infiltration and inflows from foundation drains or other drains resulting from rainfall or snowmelt; and

(iii) Stormwater runoff generated by either rainfall or snowmelt that enters the combined sewer system.

A "regulator" is any structure that in dry weather permits the passage of all flows to treatment and in wet weather permits discharge to an outfall or relief sewer of all flows in excess of some specific flowrate.

An "average year" refers to:

(i) the long term average of flow based on using simulation of at least twenty years of rainfall data and/or

(ii) a year in which the rainfall pattern (e.g. intensity, volume and frequency) is consistent with the long-term mean of the area; and/or

(iii) a year in which the runoff pattern resulting from the rainfall (e.g. rate, volume and frequency) is consistent with the long-term mean of the area.

A "swimming and bathing beach" is a strip of shoreline with the physiographic, climatic, access, and ownership attributes necessary to accommodate significant water contact and non-contact recreation under favourable aquatic conditions.

3. SEPARATE VERSUS COMBINED SEWERS

The Ministry "Guidelines for the Design of Sanitary Sewage Systems, July 1985" states that

"All new sewer construction within the Province of Ontario should be of the 'separate' type, with all forms of storm and groundwater flow being excluded to the greatest possible extent. New 'combined' sewer systems will not be approved."

However, existing combined sewers may undergo rehabilitation or be replaced by new combined sewers provided the municipality or operating authority has met the Ministry requirements as set out in this document.

4. MINISTRY REQUIREMENTS FOR MUNICIPAL & PRIVATE COMBINED SEWER SYSTEMS

To meet the goals of this Procedure each municipality or operating authority of a combined sewer system will be expected to:

(a) develop a Pollution Prevention and Control Plan (PPCP) as outlined in Section 5;
(b) meet minimum CSO controls as outlined in Section 6; and
(c) provide additional controls
- for beaches impaired by CSOs where water quality is not meeting the PWQO for E. coli as outlined in Section 9
- where required by receiving water quality conditions as specified in Procedure B_1_1 "Water Management - Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy, July 1994".

The site-specific nature and impacts of CSOs are recognized in this Procedure. There is flexibility for selecting controls for local situations.

5. POLLUTION PREVENTION AND CONTROL PLAN (PPCP)

A Pollution Prevention and Control Plan (PPCP) should be developed to meet the goals of the Procedure by:

- outlining the nature, cause and extent of pollution problems;
- examining alternatives and proposing remedial measures; and,
- recommending an implementation program.

Water quality problems may be caused primarily by combined sewer overflows or by a combination of sources including CSOs. Where the pollution problem is due to a combination of sources, the discharges will be investigated and prioritized based on the relevant significance of the various discharges. In some cases the receiving water quality and pollutant transport mechanisms will be assessed in the PPCP.

To address the impact of CSOs the components of the PPCP shall include:

(a) characterization of the combined sewer system (CSS);

- Monitoring, modelling and other appropriate means shall be used to characterize the CSS and the response of the CSS to precipitation events. The characterization shall include the determination of the location, frequency and volume of the CSOs as well as the concentrations and mass of pollutants resulting from CSOs. Through this process the existence and severity of suspected deficiencies will be confirmed. Records shall be kept for combined sewer systems including the following:

    - location and physical description of CSO outfalls in the collection system, emergency overflows at pumping stations, and bypass locations at STPs;
    - location and identification of receiving water bodies for all combined sewer outfalls;
    - combined sewer system flow and STP treatment capacities; present and future expected peak flow rates during dry weather and wet weather;
    - capacity of all regulators; and
    - location of cross-connections.

- Operational procedures shall be developed for combined sewer systems including the following:

    - combined sewer maintenance programs; and,
    - regulator inspection and maintenance programs.

(b) an examination of non-structural and structural CSO control alternatives that may include:

- source control;
- inflow/infiltration reduction;
- operation and maintenance improvements;
- control structure improvements;
- collection system improvements;
- storage technologies;
- treatment technologies;
- sewer separation.

(c) an implementation plan with cost estimates and schedule of all practical measures to eliminate dry weather overflows and minimize wet weather overflows.

- The implementation plan should show how the minimum CSO prevention and control requirements and other criteria in this Procedure are being achieved.

6. MINIMUM COMBINED SEWER OVERFLOW (CSO) CONTROLS

The minimum CSO controls consist of the following :

(a) Eliminate CSOs during dry-weather periods except under emergency conditions.

- Each municipality shall demonstrate that the combined sewer system, including the regulators, and associated treatment facilities are adequate for the transmission and treatment of all peak dry weather flows from the service area.
- An emergency condition would exist when e.g. basement flooding, damage to equipment at treatment works or pumping stations, or treatment process washout was occurring or was imminent.

(b) Establish and implement Pollution Prevention programs that focus on pollutant reduction activities at source e.g. reduced use of potential pollutants like fertilizer and pesticides in parks; public education programs on e.g. anti-littering and illegal dumping of used motor oil and other materials into catchbasins; water conservation to reduce dry weather sanitary flow and hence CSOs; street cleaning to reduce CSO floatables; roof-leader disconnection and installing rain barrels to reduce flows into the sewer system; education/assistance for industries to minimize the use/discharge of pollutants; and enforcement of municipal by-laws or regulations.

(c) Establish and implement proper operation and regular inspection and maintenance programs for the combined sewer system in order to ensure continued proper system operation.

(d) Establish and implement a floatables control program to control coarse solids and floatable materials e.g. by reducing the amount of street litter that enters the catchbasins and the CSS; by removing debris from CSOs at the outfalls using measures such as trash racks and screens; and by removing floatables from the surface of the receiving water after a CSO occurs.

(e) Maximize the use of the collection system for the storage of wet weather flows which are conveyed to the Sewage Treatment Plant for treatment when capacity is available e.g. by adjusting regulator settings.

(f) Maximize the flow to the Sewage Treatment Plant for the treatment of wet weather flows e.g. by removing obstructions to flow.

- The secondary treatment capacity should be utilized as much as possible for treating wet weather flows with the balance of flows being subject to primary treatment. Measures to increase the wet weather hydraulic capacity at the Sewage Treatment Plant (e.g. Step Feed operation) should be investigated.

(g) During a seven-month period commencing within 15 days of April 1, capture and treat for an average year all the dry weather flow plus 90% of the volume resulting from wet weather flow that is above the dry weather flow. The volumetric control criterion is applied to the flows collected by the sewer system immediately above each overflow location unless it can be shown through modelling and on-going monitoring that the criterion is being achieved on a system-wide basis. No increases in CSO volumes above existing levels at each outfall will be allowed except where the increase is due to the elimination of upstream CSO outfalls. During the remainder of the year, at least the same storage and treatment capacity should be maintained for treating wet weather flow. The treatment level for the controlled volume is described in Section 7.

7. LEVEL OF TREATMENT

The treatment processes of the sewage treatment plants should be optimized to minimize the pollutant loadings under wet weather conditions. The Pollution Prevention and Control Planning study should evaluate the operation of the Sewage Treatment Plant under wet weather conditions in consultation with Ministry Regional staff. This may lead to wet weather-specific operating conditions which may produce lower overall pollutant loadings.

During wet weather, the minimum level of treatment required for flows above the dry weather flow (as specified in sections 6 and 9) from combined sewer systems is primary treatment or equivalent. The effluent guideline for primary treatment is 30% carbonaceous biochemical oxygen demand (BOD_5) removal and 50% total suspended solids (TSS) removal for an average year during the seven month period as specified in section 6(g). The baseline for the calculation of the average pollutant removal is the influent passing the headworks of the treatment facility under wet weather conditions.

The dry weather flow from combined sewer systems is subject to the process effluent concentration criteria of the STP whether they are primary treatment plants or secondary treatment plants. During wet weather, for secondary treatment plants, the flows through the secondary treatment capacity will be subject to the process effluent concentration criteria of the STP. The flows in the STP which bypass the secondary treatment will be subject to a minimum level of primary treatment.

The treatment of wet weather flows from combined sewer systems may occur at the central Sewage Treatment Plant or at other locations such as satellite treatment facilities. Satellite treatment facilities may be built to treat wet weather flows where there are space limitations or limited capacity in the collection system to get the wet weather flows to the STP. There are a number of satellite treatment technologies some examples of which are vortex separators, high-rate sedimentation, dissolved air flotation and high-rate filtration. Satellite treatment facilities when used to treat wet weather flows from combined sewer systems are subject to the minimum level of primary treatment requirements specified above. In addition, for satellite treatment facilities the effluent concentration for total suspended solids should not exceed 90 mg/l for more than 50 % of the time for an average year during the seven-month period as specified in section 6(g).

8. EFFLUENT DISINFECTION

Effluent disinfection is required where the effluent affects swimming and bathing beaches and other areas where there are public health concerns. The local Medical Officer of Health identifies public health concerns such as e.g. whether recreational beaches are safe for swimming.

The interim effluent quality criterion for disinfected combined sewage during wet weather is a monthly geometric mean not exceeding 1000 E. coli per 100 ml. This criterion may be modified by the Regional staff of the Ministry on a case-by-case basis due to site-specific conditions.

In cases where chlorination is used as the disinfection process, subsequent dechlorination of the sewage works effluents shall be used to minimize the adverse effects of chlorine residuals on public health and the aquatic environment where necessary.

All bypasses at the Sewage Treatment Plant should be subjected to the disinfection process where available in order to reduce the bacterial loadings at discharge.

9. BEACH PROTECTION

Additional controls above the minimum CSO controls (section 6) are required for swimming and bathing beaches affected by CSOs and consist of the following :

(a) There should be no violation of the body contact recreational water quality objective (Provincial Water Quality Objectives (PWQO)) for E. coli of 100 E. coli per 100 ml. based on a geometric mean at swimming and bathing beaches as a result of CSOs for at least 95% of the four-month season (June 1 to September 30) for an average year.

(b) Controlling to not more than two overflow events per season (June 1 to September 30) for an average year in a combined sewer system with the combined total duration of the CSOs at any single CSO location being less than 48 hours and ensuring that the controlled combined sewage which does not overflow receives a level of treatment (as specified in section 7) plus disinfection (as

specified in section 8) is deemed to satisfy section 9(a). An additional overflow event per season may be allowed if the proponent can demonstrate that section 9(a) will still be satisfied and the combined total duration of the CSOs at any single CSO location will be less than 48 hours.

10. MONITORING

Monitoring of wastewater flows and overflows should be undertaken at locations within the sewer system for the purposes of assessing upgrading requirements and determining compliance with Ministry requirements. The responsibility for providing monitoring shall rest with the municipality or operating authority of the combined sewer system.

11. NEW SANITARY CONNECTIONS TO COMBINED SEWER SYSTEMS

When and where significant combined sewer system deficiencies exist, the Regional Office of the Ministry shall require that the provision of sanitary servicing for additional development tributary to the deficient system be curtailed to prevent aggravation of the problem until the necessary upgrading, as outlined by a Pollution Prevention and Control Plan is carried out in keeping with the requirements of this Procedure. Some development is allowed as upgrading proceeds, conditional upon its progress. The staged upgrading should at a minimum provide for the transmission and treatment of all flows from the additional development.

This provision applies to significant development i.e. not to simple, one lot infill cases.

12. NEW STORM CONNECTIONS TO COMBINED SEWER SYSTEMS

New storm drainage systems shall not be permitted to connect to existing combined systems if that increases the gross area serviced by the combined sewer system except where evaluations indicate that circumstances allow no other practical alternative. The evaluations must be documented as part of a Pollution Prevention and Control Plan.

"Piece-meal" construction on existing combined sewer systems will be permitted only with overriding justification such as for the purpose of relocation (e.g., to accommodate underground utilities, subway structures, new buildings and pedestrian tunnels, etc.) or for the purpose of capacity improvement (e.g., to relieve basement flooding or to provide emergency additional conveyance capacity to treatment works to reduce overflows) or for rehabilitating deteriorated sewer conditions.

13. ENFORCEMENT

Procedure F-5-5 will be used to:

(a) review applications for approval to ensure that the proponent is in compliance with the Procedure prior to the issuance of a Certificate of Approval.

(b) assist regional staff in setting minimum requirements in preparing Control Orders to bring systems into compliance with the Procedure.

(c) assist enforcement staff in evaluating a combined sewer system operator's due diligence when investigating violations of the Environmental Protection Act and/or the Ontario Water Resources Act.

Any deviation or relaxation from this Procedure should be reviewed by the Regional Director and the Director, Program Development Branch.

APPENDIX A

APPENDIX B – DISPOSAL ALTERNATIVES

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
General Construction and Painting			
Excess paint (oil based)	1. Recycle/reuse. 2. Dispose as hazardous waste.		1. Recycle/reuse. 2. Take to HHW drop-off.
Excess paint (water-based)	1. Recycle/reuse. 2. Dry residue in cans, dispose as trash. 3. If volume is too much to dry, dispose of as hazardous waste.		1. Recycle/reuse. 2. Dry residue in cans, dispose as trash. 3. If volume is too much to dry, take to HHW drop-off.
Paint clean-up (oil based)	Wipe paint out of brushes, then : 1. Filter & reuse thinners and solvents. 2. Dispose as hazardous waste.		Wipe paint out of brushes, then: 1. Filter & reuse thinners and solvents. 2. Take to HHW drop-off.
Paint clean-up (water based)	Wipe paint out of brushes, then: 1. Rinse to sanitary sewer.		Wipe paint out of brushes, then: 1. Rinse to sanitary sewer.
Building exterior cleaning (high-pressure water)	1. Prevent entry into storm drain and remove off site.Wash onto dirt area, spade into soil.Collect (e.g. mop up) and discharge to sanitary sewer.	Waste Water Treatment Plant	

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
General Construction and Painting continued			
Cleaning of building exteriors which have **HAZARDOUS MATERIALS** (e.g. mercury, lead) in paints	1. Use dry cleaning methods. 2. Contain and dispose washwater as hazardous waste (Suggestion: dry material first to reduce volume).		
Non-hazardous paint scraping/sand blasting	1. Dry sweep, dispose as trash.		1. Dry sweep, dispose as trash.
HAZARDOUS paint scraping/sand blasting (e.g. marine paints or paints containing lead or tributyl tin)	1. Dry sweep, dispose as hazardous waste.		1. Dry sweep, take to HHW drop-off.

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
General Construction and Painting; Street and Utility Maintenance			
Soil from excavations during periods when storms are forecast.	1. Should not be placed in street or on paved areas. 2. Remove from site or backfill by end of day. 3. Cover with tarpaulin or surround with silt fence. 4. Place filter cloth over catchbasin. Note: Thoroughly sweep following removal of dirt in all four alternatives.		
Soil from excavations placed on paved surfaces during periods when storms are not forecast.	1. Keep material out of storm conveyance systems.		
Cleaning streets in construction areas.	1. Dry sweep and minimize tracking of mud. 2. Use silt ponds and/or similar pollutant reduction techniques when flushing pavement.		
Soil erosion, sediments	1. Cover disturbed soils, use erosion controls, filter flows into storm drain. 2. Revegetate immediately.		

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
General Construction and Painting; Street and Utility Maintenance continued			
Fresh cement, grout, mortar.	1. Use/reuse excess. 2. Dispose to trash.		1. Use/reuse excess. 2. Dispose to trash.
Washwater from concrete/mortar (etc.) cleanup.	1. Wash onto dirt area and spade in. 2. Pump and remove to appropriate disposal area. 3. Settle, pump water to sanitary sewer.	Waste Water Treatment Plant	1. Wash onto dirt area and spade in. 2. Pump and remove to appropriate disposal area. 3. Settle, pump water to sanitary sewer.
Aggregate wash from driveway/patio construction.	1. Wash onto dirt area, spade in. 2. Pump and remove to appropriate disposal area 3. Settle, pump water to sanitary sewer.	Waste Water Treatment Plant	1. Wash onto dirt area and spade in. 2. Pump and remove to appropriate disposal area. 3. Settle, pump water to sanitary sewer.
Rinsewater from concrete mixing trucks.	1. Return truck to yard for rinsing into pond or dirt area. 2. At construction site, wash into dirt area.		
Non-hazardous demolition and construction debris.	1. Recycle/reuse (concrete, wood, etc.) 2. Dispose as trash.		1. Recycle/reuse (concrete, wood, etc.) 2. Dispose as trash.

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
General Construction and Painting; Street and Utility Maintenance continued			
Hazardous demolition and construction debris (e.g. asbestos).	1. Dispose as hazardous waste.		1. Do not attempt to remove yourself. Contact an asbestos removal service for safe removal and disposal.
Saw-cut slurry.	1. Use dry cutting technique and sweep up residue. 2. Vacuum slurry and dispose off-site. Block storm drain or berm with low weir as necessary to allow most solids to settle. Shovel out gutters; dispose of residue to dirt area or landfill.		

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
General Construction and Painting; Street and Utility Maintenance continued			
Construction dewatering (Non turbid, uncontaminated groundwater).	1. Recycle/reuse. 2. Discharge to storm sewer.		
Construction dewatering (Other than non turbid, uncontaminated groundwater).	1. Recycle/reuse. 2. Discharge to sanitary sewer. 3. As appropriate, treat prior to discharge to storm sewer.	Waster Water Treatment Plant	
Portable toilet waste.	1. Leasing company shall dispose to sanitary sewer.	Waste Water Treatment Plant	
Leaks from garbage dumpsters.	1. Collect, contain leaking material. Eliminate leak, keep covered, return to leasing company for repair. 2. If dumpster is used for liquid waste, use plastic liner.		
Potable water-line flushing . Hydrant testing.	1. Deactivate chlorine by maximizing time water travel before reaching waterbodies.		
Super -chlorinated (above 1 ppm) water from line flushing.	1. Discharge to sanitary sewer. 2. Complete dechlorination required before discharge to storm drain.		

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL Disposal Priorities	Approval	RESIDENTIAL Disposal Priorities
Landscape/Garden Maintenance			
Pesticides	1. Use up. Rinse containers; use rinsewater as product. Dispose rinsed containers as trash. 2. Dispose unused pesticide as hazardous waste.		1. Use up. Rinse containers; use rinsewater as product. Dispose rinsed containers as trash. 2. Take unused pesticide to HHW drop-off.
Garden clippings	1. Compost. 2. Take to Landfill.		1. Compost. 2. Dispose as trash, separate as yard waste if a separate service is offered.
Tree Trimming	1. Chip if necessary, before composting or recycling.		1. Chip if necessary, before composting or recycling.
Swimming pool, spa, fountain water (emptying)	1. Do not use metal-based algaecides (i.e. Copper Sulphate). 2. Recycle/reuse (e.g. irrigation). 3. Determine chlorine residual = 0, wait 24 hours then discharge to storm drain.		1. Do not use metal-based algaecides (i.e. Copper Sulphate). 2. Recycle/reuse (e.g. irrigation). 3. Determine chlorine residual = 0, wait 24 hours then discharge to storm drain.
Acid or other pool/spa/fountain cleaning	1. Neutralize and discharge to sanitary sewer.	Waste Water Treatment Plant	
Backwash from swimming pool, spa filter	1. Reuse for irrigation. 2. Dispose to dirt area. 3. Settle, dispose to sanitary sewer.		1. Use for landscape irrigation. 2. Dispose on dirt area. Settle, dispose to sanitary sewer.

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
Vehicle Wastes			
Used motor oil	1. Use secondary containment while storing. 2. Send to recycler.		1. Put out for curbside recycling pickup where available. 2. Take to Recycling Facility or auto service facility with recycling program. 3. Take to HHW events accepting motor oil.
Antifreeze	1. Use secondary containment while storing, send to recycler.		1. Take to Recycling Facility.
Other vehicle fluids and solvents	1. Dispose as hazardous waste.		1. Take to HHW event.
Automobile batteries	1. Send to auto battery recycler. 2. Take to Recycling Center.		1. Exchange at retail outlet. 2. Take to Recycling Facility of HHW event where batteries are accepted.
Motor home/construction trailer waste	1. Use holding tank. Dispose to sanitary sewer.		1. Use holding tank. Dispose to sanitary sewer.
Vehicle leaks at Vehicle Repair Facilities	Follow this 3-step process. 1. Clean up leaks with rags or absorbents. 2. Sweep, using granular absorbent material (cat litter). 3. Mop and dispose of mopwater to sanitary sewer.		

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
Other Wastes			
Carpet cleaning solutions and other mobile washing services	1. Dispose to sanitary sewer.	Waste Water Treatment Plant	1. Dispose to sanitary sewer.
Roof drains	1. If roof is contaminated with industrial waste products, discharge to sanitary sewer. 2. If no contamination is present discharge to infiltration trenches or storm sewer.		
Cooling water Air conditioning condensate	1. Recycle/.reuse. 2. Discharge to sanitary sewer.	Waste Water Treatment Plant	
Pumped groundwater, infiltration/ foundation drainage (contaminated)	1. Recycle/reuse (landscaping, etc.). 2. Treat if necessary; discharge to sanitary sewer. 3. Treat and discharge to storm drain.	Waste Water Treatment Plant	
Kitchen Grease	1. Provide secondary containment, collect, send to recycler.		1. Collect, solidify, dispose as trash.
Clean-up wastewater from sewer back-up	1. Follow this procedure. Block storm drain, contain, collect, and return spilled material to the sanitary sewer.		

APPENDIX B

APPENDIX C - AVAILABLE PUBLIC OUTREACH MATERIALS

This summary includes materials provided at the start up of the project and new materials collected.

AGENCY	CONTACT	DESCRIPTION OF MATERIAL	FOCUS OF PROGRAM OR MATERIAL		
			FLOW REDUCTION	POLLUTION PREVENTION	WATER CONSERVATION
American Water Resources Association	950 Herndon Parkway, Suite 300 Herndon, Virginia 2207-5528, USA Phone: (703) 904-1225 Fax: (703) 904-1228	**Poster** How do we treat our wastewater?		X	
American Water Works Association	(303) 794-7711	**Brochures and booklets -** pocket size *Water Conservation at Home (1996)* *25 Things You Can do to Prevent Water Waste (1989)*	X		X
Barrie Public Utilities Commission	(705) 739-4254	**Water Conservation Program** Reduced costs or rebates for low flow toilets, aerators and showerheads. 1997 Lawn watering restrictions	X		X
Burlington, City of	City of Burlington, Ontario, Engineering Department (905) 335-7694	**Brochure** *Healthy Creeks - A shared responsibility*		X	

Cambridge, City	Cambridge City Green Strategy. (519) 740-4650, ext. 4526.	**Rain Barrel promotion.** Rain Barrels, benefits, essentials, etc. Information brochure about rain barrel purchase. **Brochure:** *Alternatives to Pesticides for Health's Sake*- lawn care, pesticide alternatives.	X	X	X
Canadian Parks Service. Friends of Fort George.	Friends of Fort George P. O. Box 1283 Niagara-on-the-Lake ON L0S 1J0	**Sewage Waste Amendment Marsh Process (SWAMP)** *Brochure. A green way to treat sewage: Let cattails do it!*		X	
Center for Watershed Protection	(410) 461-8323	**Bulletin, quarterly** Watershed Protection Techniques	X	X	X
CMHC's Healthy House, Toronto	(416) 218-3343	**Healthy House Project 1996** Handout describing the drinkable water and waste water management project.	X	X	X

Cornwall, City of	City of Cornwall Environmental Services Department (613) 937-1777	**Booklet** *Enviropedia - A guide to solid waste management, alternative cleaners, water and energy conservation.*	X	X	X
Credit Valley Conservation	Credit Valley C.A. (905) 670-1615 or 1-800-668-5557.	**Brochure:** *Your Water: What you should know* -A guide for Orangeville residents.	X	X	X
Environment Canada	Enquiry Centre (819) 997-2800 or 1-800-668-6767	**Freshwater Series.** Several comprehensive booklets on many aspects of water and environmental citizenship. **Booklet** What We Can Do for Our Environment (Green Plan) **Book** *A Primer on Fresh Water*	X	X	X
Etobicoke, City of	Rob Klimas, Manager Storm Drainage (416) 394-8379	**Rain Barrel Pilot Project (1994)** Summary of project, survey and distributed household flyers.	X		X

Green Thumb Project	Lake Ontario area contact: Lois Corbett or Janet May. (416) 348-0660	**Green Thumb Project** (Education project for schools, parks and homeowners. **Handout** - turf management concerns, pesticide use, & importance to the Great Lakes.		X	
City of Hamilton (Former Hamilton – Wentworth Region)	Hamilton General Inquiries (905) 546-4417	**Booklet** *Enviro-Guide. For students and residents of Hamilton Wentwork 1996* **Brochures** *Green Venture information of home green up.* *Spills* *Yellow Fish Road Storm Drain Awareness Program* *Recycling just got easier in Hamilton-Wentworth* **Misc** Pogs - *Never Lose Focus*		X	X

Toronto Region Conservation Authority	Toronto Region CA Customer Service (416) 661-6600 for Brochure listing models and displays available for loan to non-profit groups. www.trca.on.ca	**Panel displays:** *Caring for Water (urban)* *After the Rain* - hydrologic cycle, stormwater management. **Factsheets:** *After the Rain* series. *Where Does the Rain Go?* *What is Stormwater Management?* *Managing Stormwater: Constructed Wetlands.* *Meet a Wetlands Plants.* **Models:** *Caring for Water* illustrating flow pathways and water-management do's and don'ts. *Groundwater Simulation Model* hydrogeological concepts.	X	X	X
Natural System Group	(416) 977-5079	**Foldout:** Pictorial depiction of alternative at-source pollution, volume control measures, drawbacks to Western Beaches Storage Tunnel.	X	X	

New York State Water Resources Institute	Centre for Environmental Research, Cornell University.	**Bulletins** *#1 - What is groundwater?* *#2 - Groundwater contamination* *#3 - Aquifers*		X	
Niagara Falls, City of	Brad Simpson Municipal Works Office (905) 356-7521, ext. 4102	**Downspout disconnection program** posters, door knob hangers. *Water Conservation Program information booklet.*	X		
Project Green, Windsor, Ontario	(519) 25-GREEN	**Water Saver** Flyer with advantages and purchasing information for rain barrels. Products and services brochure and price list.	X		X

St. Catharines, City of	Cindy Toth, Pollution Control Plan Coordinator. (905) 688-5600 ext. 693	**Brochures** *Downspout disconnection information.* *What's the connection between downspouts and St. Catharines beach closings?* *St. Catharines is a Beach Front Property* *Use Water Wisely - Water Saving Devices* *Water Wise Tips for Kitchen and Laundry* *Water Wise Tips for the Summer Season* *Water Audit - Water Wise Tips for Bathrooms* **Posters** The 3 r's of Water Conservation Our Waterways are for people to enjoy. **Misc.** Buttons - It's Worth It! waste reduction, recycling Stickers - Be Water Wise Refrigerator magnets - Be Water Wise	X	X	X

Toronto Environmental Alliance.	(416) 596-0660	**Handout:** *Green Lawns - A Guide to Environmentally Sound Lawn Care.* *Non-Toxic White Grub Control* *Toxic Challenge - Home Toxics Audit.* *Healthy Home Pledge* *Detox newsletter*		X	
Toronto, City of	City Works Service (416) 392-1807	**Downspout disconnection & rainbarrel program.** Handouts: *Recycle Your Rain* - Information flyer. *Recycle Your Rain* - Postcard for information on the downspout disconnection program. *Cleaner beaches through downspout disconnection* (multilingual) *Tap into a good thing* - Water meter program information	X		X

Toronto, Metro Works	Environmental Promotion and Consultation Branch (416) 397-7100	**Booklets and handouts:** *Get a great lawn with all the trimmings* *Newsletters: Waste Watch, Water Watch* *Seasonal Information handouts - xeriscaping, groundcovers, grass seeding.* *Household Hazardous Waste - non hazardous alternatives.* *Guide to Hazardous Waste in the Home.* *Commercial and Industrial Waste Reduction. several handouts with checklists and information.* *Be Good to Your Garden - Compost.* *Why you should make and use compost* *Worm your way into composting (vermiculture)* *Composting handouts: the value of compost; composting with worms; community composting; pestproofing your compost bin; vermiculture; odour control; composting resources.*	X	X	X
Water Environment Federation, Virginia USA	601 Wythe Street Alexandria, VA 22314-1994 (703) 684-2438 (703) 684-2400	**Brochure** *Household Hazardous Waste - What you should and shouldn't do.* *Non-point Source Pollution. You are the key to the cleanup.* **Resource guides for students and teachers**		C	

Waterloo, Regional Municipality	Water Efficiency Section (519) 575-4423	*Water Resources Protection Strategy Groundwater Protection Options* (Mike Murray, discussion paper) *Water Resources Protection Strategy Implementation Plan Long Term Water Strategy - Executive Summary Phase I Report* *Groundwater Protection Areas Policy Discussion Paper (1996)* *Sewer Use By-Law* *Water Quality Data Report for the Region's Municipal Water Supply System., Oct 95 to Dec. 96.* *Water Supply - Treatment, distribution, integration.* Residential Toilet Replacement Program - registration details and program information. **Brochures:** *Facts about Waterloo Region's Drinking Water Quality* *40 Ways to be water wise* *A Guide to Water Softeners* *Water - Ours to Protect* *Healthy Lawns and Gardens with Less Water* *Don't Trash Your Grass* *Alternatives to Pesticides - Naturally* *Naturescaping*	X	X	X

Waterloo, Regional Municipality con't		*Plant and Mulch Guide Plant Guide for the Greenbrook Demonstration Gardens* *Composting - the natural choice.* *Where can I buy a rain barrel?* *Residential Toilet Replacement Program $50 Rebate* *Hazardous Waste Days Schedule* *Where does it all go? Waste Management Division* *Take care of your land - Best Management Practices* *Take care of your land - Well and home water protection.* *Water Pollution Prevention Fact Sheets (draft 1998)* **Newsletter** ***Environews & Industrial Perspectives newsletter*** **Children's material** *Be a Friend to Your Planet Earth - household hazardous waste activity and colouring book.* **Other** Shower timer Toilet tank leak detector Drip Disk Outdoor Water Saver			
United States. Environmental Protection Agency	Email: public-access@epa.gov	Teachers and students education kits			